(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
4 April 2002 (04.04.2002)

PCT

(10) International Publication Number
WO 02/27639 A1

(51) International Patent Classification[7]: G06F 19/00

(21) International Application Number: PCT/US01/30489

(22) International Filing Date:
28 September 2001 (28.09.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
09/675,999 28 September 2000 (28.09.2000) US

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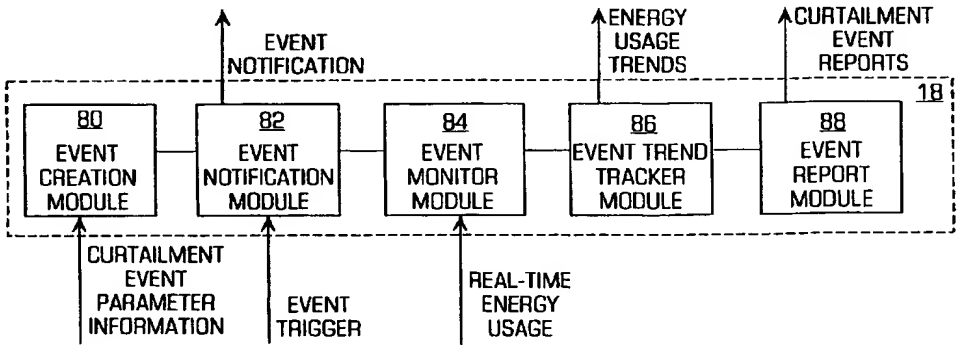
(81) Designated States *(national)*: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*
— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: SYSTEM AND METHOD FOR ENERGY USAGE CURTAILMENT



(57) Abstract: The present invention affords a system and method for creating, monitoring, and settling energy curtailment events. By using the invention, users may respond to and benefit from requests for energy load reduction. Advantageously, energy curailment events may be issued in the aggregate, or may be customized, and end-user participation may be logged and can be presented in a variety of different forms to both consumers and service provider operators.

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SYSTEM AND METHOD FOR ENERGY USAGE CURTAILMENT

The present invention is related to a system and method for managing the use of energy.

BACKGROUND OF THE INVENTION

Energy management and energy cost management has always been an issue for many operators of large physical plants, such as facilities and/or factories, because of the large amount of energy that is consumed by such plants. It is desirable to manage and analyze the energy consumption of the physical plant in order to reduce the total energy costs of the physical plant.

Energy management becomes especially complex for large entities, such as corporations, universities, municipalities, etc., which may have a physical plant with many different facilities or factories located at various different locations. With a conventional energy management approach, each facility owned by the large entity may independently manage its own energy. Thus, for a large entity, there must be a conventional energy management system associated with each facility or factory, which greatly increases the overall costs of conventional energy management. In addition, each energy management system may use a slightly different data structure for the data being generated so that these multiple energy management systems cannot be easily integrated into a single energy management system for the entire physical plant.

Moreover, during peak energy demand periods, utilities and service providers are often forced to purchase short-term energy resources at prices that are significantly higher than average and pass on the high costs to its energy customers. Failure of utilities and service providers to maintain adequate energy resources can lead to power outages that affect the general public and can tarnish the reputation of the utilities and service providers and adversely affect their business. As a result, utility and service providers often lose millions of dollars every day in order to maintain adequate energy resources.

In order to manage peak energy demand periods, some utilities and service providers establish reduction compensation programs and pay consumers to temporarily reduce their energy consumption during peak energy demand periods. Advantageously, consumers electing to participate in a curtailment event (i.e., compensation program) may be incentivized by being able to purchase energy during peak energy demand periods at energy

costs lower than normally available. However, due to the high volatility of wholesale energy prices and the absence of energy management systems for determining real-time information tracking energy usage, consumer participation in reduction compensation programs is limited.

To achieve large-scale energy reduction programs, utilities and service providers need to be able to rapidly inform consumers of high energy cost periods. Unfortunately, current curtailment programs lack historical data relating to high cost energy consumption by consumers, and do not rapidly inform consumers of peak energy demand periods. Thus, consumers generally are not afforded a cost savings benefit by participating in curtailment programs. Moreover, since wholesale power markets are ordinarily highly volatile, delays and notice periods can cause mismatches between the cost of energy actually purchased by the consumer and the market value of that purchased energy.

Further, conventional curtailment systems typically notify consumers of peak energy demand periods by broadcast facsimile or telephone messages, and conventional curtailment program administration does not currently support grouping consumers by program design, likely response, load zone, or other means. Conventional curtailment systems also do not provide the capability for both a service provider operator and a consumer user to view, in real-time, the results of participating in an energy reduction program.

Thus, there is a need for a system and method that afford customization of curtailment events for individual consumer users and provide real-time notification and monitoring of curtailment events. It is to these ends that the present invention is directed.

SUMMARY OF THE INVENTION

The present invention affords a system and method for creating, monitoring, and settling energy curtailment events. By using the invention, users may respond to and benefit from requests for energy load reduction. Advantageously, energy curtailment events may be issued in the aggregate, or may be customized for each customer according to a curtailment program design, customer type or location. Advantageously, data gathering and event participation patterns may also be customized, and end-user participation may be logged and can be presented in a variety of different forms to both consumers and service provider operators.

In an aspect of the invention, a system for performing energy load management within a network includes an energy service provider node for providing energy to the network and a plurality of client nodes for receiving portions of the provided energy from the energy service provider node to operate energy dependent devices within the client nodes. Additionally, a server for coordinating energy load management within the network is provided and includes an event creator for creating an energy curtailment program, an event notifier for initiating the energy curtailment program and for notifying any of the client nodes of the energy curtailment program so that the client nodes may elect to participate in the energy curtailment program, an event monitor for monitoring the progress of the energy curtailment program in reducing energy usage of the participating client nodes, and an event reporter for generating report results relating to the energy curtailment program. An event trend tracker for tracking energy usage of different client nodes over a period of time may also be included. A database is also associated with the server for storing energy usage information about the energy usage of the client nodes and for storing energy curtailment program information.

In features of the invention, each of the facilities in the plurality of client nodes may include an internal data source and an external data source for generating data about a respective facility that is used for energy management. The internal data source may include a building control gateway for providing two-way data communications between existing controls of the facility and an energy management system associated with the facility, a meter gateway for providing data to the associated energy management system about the energy usage of the facility, and a weather gateway for providing weather data to the associated energy management system. The external data source may include a market energy rates source for providing energy cost information relating to different energy providers and a weather data source for providing future weather forecast information.

In another feature of the invention, each facility may also include a local energy management system. The local energy management system may include an energy manager sub-system for analyzing energy usage data, a facility navigator sub-system for permitting simulated visualization of the facility, a facility manager sub-system for analyzing control problems within the facility, and an alarm manager sub-system for notifying the consumer of and responding to system generated alarms.

In another aspect of the invention, a computer program product for use in performing energy load management within a network includes an event creation software module for creating an energy curtailment program, an event notifier software module for initiating the energy curtailment program and for notifying of the initiation of the energy curtailment program so that participation in the curtailment program may be elected, an event monitor software module for monitoring and recording the progress of the energy curtailment program in reducing energy usage within the network during the energy curtailment program, and an event reporter software module for generating report results relating to the energy curtailment program. The computer program may also include an event trend tracking software module for tracking energy usage trends within the network.

In yet another aspect of the invention, a computer program residing on a computer-readable medium causes a computer system to receive a creation command to create an energy curtailment program, receive a select command for selecting to initiate the energy curtailment program, transmit a notification alert to any of a plurality of client nodes about the initiation of the energy curtailment program, receive a participation command from the notified client nodes to associate the energy curtailment program with those client nodes electing to participate in the energy curtailment program, monitor the progress of the energy curtailment program in reducing energy usage by the participating client nodes, and receive a report command to generate report results relating to the energy curtailment program.

In still another aspect of the invention, a method for performing energy load management within a network comprises the steps of receiving energy curtailment program parameter information to create an energy curtailment program, initiating the energy curtailment program, notifying any of a plurality of client nodes about the initiation of the energy curtailment program by providing the energy curtailment program parameter information and baseline energy usage information to the client nodes to assist the notified client nodes in electing whether to participate in the energy curtailment program, and monitoring and recording the progress of the energy curtailment program in reducing energy usage by the participating client nodes.

In a feature of the invention, the baseline energy usage information is determined according to a predetermined baseline algorithm. The baseline algorithm may determine an average energy load during the five highest energy consuming days occurring over a thirty

day time period and that result may be used as the baseline energy usage information. The baseline algorithm may alternatively determine estimated baseline information by determining the energy usage occurring over a one hour time period occurring one day and two hours prior to the scheduled beginning of a curtailment program, and once the curtailment program begins, the baseline algorithm may substitute actual baseline information for the estimated baseline information by determining energy usage over a one hour time period occurring two hours prior to the start of the curtailment program.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a diagram illustrating a load curtailment system in accordance with the invention;

Fig. 2 is a diagram illustrating, in more detail, sub-system components of a local energy management system shown in Fig. 1;

Fig. 3 is a diagram illustrating a curtailment manager software application in accordance with the invention;

Figs. 4A-4E are exemplary representations of a user interface that may be displayed to a service provider operator upon accessing the event creation software module of the curtailment manager software application shown in Fig. 3 to create a new curtailment event;

Fig. 5 is an exemplary representation of a user interface that may be displayed to a service provider operator upon accessing the event notification software module of the curtailment manager software application shown in Fig. 3 to initiate a curtailment event;

Fig. 6 is an exemplary representation of a user interface that may be displayed to a consumer upon accessing the event notification software module of the curtailment manager software application shown in Fig. 3 to respond to a curtailment event notification;

Fig. 7 is an exemplary representation of a user interface that may be displayed to a consumer for viewing facility-specific energy information;

Fig. 8 is an exemplary representation of a user interface that may be displayed to a service provider operator upon accessing the event monitor software module of the curtailment manager software application shown in Fig. 3 to view the progress of a curtailment event;

Fig. 9 is an exemplary representation of a user interface that may be displayed to a consumer upon accessing the event monitor software module of the curtailment manager software application shown in Fig. 3 to view the progress of participating in a curtailment event;

Fig. 10 is an exemplary representation of a user interface that may be displayed to both a consumer and a service operator upon accessing the event trend tracker software module of the curtailment manager software application shown in Fig. 3 to view energy usage trend information;

Fig. 11 is an exemplary representation of a user interface that may be displayed to a service provider operator upon accessing the event report software module of the curtailment manager software application shown in Fig. 3 to generate and view curtailment event report information;

Fig. 12 is an exemplary representation of a user interface that may be displayed to a consumer upon accessing the event report software module of the curtailment manager software application shown in Fig. 3 to generate and view curtailment event report information; and

Fig. 13 is a flowchart illustrating a preferred operation of the system in accordance with the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Fig. 1 is a diagram illustrating a load curtailment system 10 in accordance with the invention. As shown, the load curtailment system 10 may include a server 12 connected with one or more client nodes 14 across a wide area network (WAN) 16, such as the Internet, or more particularly, the World Wide Web. It should be noted that while the invention is described as being provided over the World Wide Web, it may also be provided over a local area network, such as an intranet, and other network structures.

The server 12 may include a software application 18 for performing energy management functions within the network. A database 20 may be associated with the server 12 for storing curtailment event and other information relating to different client nodes 14 within the system 10.

The client nodes 14 may be associated with respective entities, such as energy consumers and/or utility providers. Entities may be located in physically distinct locations and may include a plurality of geographically distinct facilities, such as different buildings of a university or the like. For example, an entity 22 may include a plurality of buildings 23a,

23b and a local energy management system 24 within the entity 22 may manage the energy usage at the different facilities 23a, 23b.

Some of the facilities 23a, 23b may include, for example, devices that operate and consume energy, such as an HVAC unit 26. Advantageously, a connected device interface (not shown) may be associated with these systems for gathering energy consumption and operation data about the one or more devices connected to the device interface. These interfaces are described in more detail in Applicant's co-pending Patent Application, Serial No. _____, entitled "_____," which is owned by the same Assignee, and is hereby incorporated herein by reference.

Further, a server (not shown) may be connected to the device interface and may store the energy consumption and operation data for each device at the facility. In addition, each facility 23a, 23b may include one or more internal data sources and one or more external data sources. The internal data sources may be devices internal to the facility that generate data about the facility used for energy and/or facility management. For example, the internal data sources may include a building control gateway 32 which provides one or two-way data communications between the existing controls of the facility and the energy management system 24, a meter gateway 34 which provides data to the energy management system 24 about the energy usage of the facility, and a weather gateway 36 which provides various weather data, such as humidity or temperature, to the energy management system 24.

The external data sources may be data sources that are outside of the particular facility, but which also provide data which is useful for energy and facility management. For example, the external data sources may include a market energy rates source (not shown) which contains data about the energy costs for various energy providers and a weather data source (not shown) for providing future weather forecasts for each facility. Using the various data from the internal and external data sources, the energy and facility management apparatus may, for example, track energy usage or change energy usage patterns based on the forecast weather or based on a less expensive energy provider.

As described above, the entity 22 may include a local energy management system 24. The local energy management system 24 may be divided into one or more sub-systems which

manage different portions of the physical plant of the entity. Fig. 2 is a diagram illustrating, in more detail, the sub-systems that may comprise the local energy management system 24.

As shown in Fig. 2, the local energy management system 24 may include an energy manager sub-system 40, a facility navigator sub-system 42, a facility manager sub-system 44 and an alarm manager sub-system 46. Each of these sub-systems performs operations that permit control and management of an entity's facilities including its energy consumption. For example, the energy manager sub-system 40 may track and/or analyze energy usage data, the navigator sub-system 42 may permit simulated visualization of each facility, the facility manager sub-system 44 may analyze control problems in the facility, and the alarm manager sub-system 46 may notify of and respond to alarms as appropriate. Each of these sub-systems work together to provide an integrated energy and facility management system. Operation of these sub-systems is disclosed in more detail in the above referenced co-pending Patent Application, which has been incorporated herein by reference. These sub-systems will be briefly described below.

The energy manager sub-system 40 gathers energy usage data and permits users of the system 10 to view and analyze energy usage over any combination of facilities or time periods. The energy manager sub-system 40 may permit the user to diagnose energy usage problems and develop strategies to reduce energy costs by optimizing responses to queries by the user based on the time of day, the current energy rate and environmental conditions. The energy manager sub-system 40 may receive data from a variety of sources, such as utility meters 34 (Fig. 1) in the facility.

The energy manager sub-system 40 may perform a variety of functions, such as tracking energy usage, analyzing energy usage by analyzing historical energy usage data or analyzing energy load aggregation data, energy rate analyzing, energy usage forecasting based on various data such as forecast weather conditions, power procurement analyzing, such as generating a request for purchase (RFP), analyzing the energy usage of different sites and comparing the sites to each other, and alarm signaling. Energy usage tracking may include monitoring and generating trends for real-time energy usage of each facility in various energy units, such as kilowatts (KW), kilowatt hours (KWH), or British thermal units (BTUs). The usage tracking may also include aggregating energy loads for the various

facilities 23a, 23b and retrieving and comparing historical energy usage with real-time energy usage.

The energy usage analysis may include an energy load shape analysis, a peak energy demand determination, an identification to determine the largest energy consumers and/or the consumers who use the energy during the peak energy usage time, and a determination of energy load and energy power factors. The rate analysis may include determining energy costs based on existing rates on a per meter, per building, per site, per cost center or corporate-wide basis, an energy load scenario builder in which different energy rates scenarios may be analyzed to determine the best rate for the entity compared to a base scenario, generating energy bills, and viewing real-time and historical energy demand levels on a per meter, per building, per site, per cost center or corporate-wide basis.

Finally, usage forecasting may use weather data to forecast a future day, week, month or year's energy usage. An alarm signaling function may generate an alarm signal when certain conditions occur, such as energy load peaks, power spikes, surges, sags and deviations from an acceptable signal quality.

The facility navigator sub-system 42 may permit any user of the energy management system 24 who is connected to the system 10 by the WAN 16 (Fig. 1) to view real-time two-dimensional or three-dimensional representations of any facility 23a, 23b at the entity 22, to configure a particular site, to analyze and locate energy or facility management problems at a site, or to generate a report. In particular, the facility navigator may permit a user to navigate and analyze problems at multiple sites using advanced 2-D and 3-D visualization tools.

The navigator sub-system 42 (operating in two-dimensional mode) may generate graphical representations of the details of the facilities, sites and the like to permit a user to navigate through all of the sites, through a site to a specific building on a site, or through a particular building on a site. The navigator sub-system 42 may also generate visual representations of an event, such as an alarm or excessive power usage, so that a user may view these events when they are navigating through the site or building. As an example, the navigator sub-system 42 may display a particular building as red indicating that the building is using too much power based on past history and a user of the navigator may view the red building and may investigate the problem. The navigator sub-system 42 may also permit a

user to look at individual systems in a building, such as HVAC system 26 or equipment components, to analyze a problem. The navigator sub-system 42 operating in three-dimensional mode may perform similar functions as when operating in two-dimensional mode, except that three-dimensional models of the site/building are shown.

The facility manager sub-system 44 may integrate existing building control systems to permit a user of the energy management system 24 to have access to data from the existing building control systems as well as newly installed systems so that the energy management system 24 may be easily integrated with existing systems. The facility manager sub-system 44 may perform data monitoring and collection processes which may include monitoring, trending and archiving data (i.e., temperatures, pressures, flows, levels, set points and states) about existing systems, such as HVAC systems, boilers, chillers, cooling towers, generators, compressors, motors and pumps and lighting.

The facility manager sub-system 44 may also monitor and trend (i.e., determine a trend and how the particular quantity will act in the future) environmental conditions, such as lighting, interior and exterior temperatures, relative humidity, solar radiation and the like. The facility manager sub-system 44 may also monitor and display peak facility operating periods, and analyze equipment efficiencies under partial and full load, develop operating efficiency load profiles, track operating hours and benchmark load profiles against capacity ratings.

The facility manager sub-system 44 may also optimize existing systems by, for example, balancing HVAC operating times to meet building use periods and environmental changes, and optimize existing equipment's energy usage. The facility manager sub-system 44 may also control existing systems and devices and initiate soft starts, hard starts and stops of the equipment, program control set-points and provide a manual override of the systems and equipment.

The alarm manager sub-system 46 handles any alarms generated at any point in the energy management system 24 or at a facility 22. For example, it may collect and prioritize alarm information from the energy manager sub-system 40 or the facility manager sub-system 44. The alarm manager sub-system 46 may also notify appropriate people, by various different methods, such as e-mail, fax or pager, who need to respond to a particular alarm.

Referring again to Fig. 1, other client nodes 14 may include singular entities 50, such as large factories or the like, or energy providers 52. Energy providers 52 typically include large power plants 54 for providing energy to other client nodes 14 within the network, and a large array of metering systems 36 for tracking the energy usage of the client nodes 14 within the network to determine the aggregate energy usage within the network. The energy providers 52 may also include data gateways and a local energy management system, such as described above.

As described above, the system 10 may include the server 12 having one or more software applications 18 for performing energy management functions within the network 10. Advantageously, the server 12 may be accessed by a plurality of client computer systems 60 over the WAN 16. The client computer systems 60 may be located within the different entities 22 or may be external to the entities 22.

The client computer systems 60 may include a display device 62, a CPU unit 64, one or more user input devices, such as a mouse 66 and a keyboard 68 and may be configured to communicate with the server 12 over the WAN 16. The CPU unit 64 may house a permanent storage system 70, such as a hard disk drive, optical disk drive, tape drive, or the like, which may store one or more software applications such as a web browser application. The client computer systems 60 may have a resident memory 72 and the software application from the disk 70 may be transferred to the memory 72 to be executed by a CPU 74. A browser application may connect the client computer systems 60 to the server 12 over the WAN 16 and receive data and graphical information (such as web pages, reports, etc.) that may be displayed on the display device 62 of the client computer system 60. The browser application may also permit the client computer systems 60 to interact with the server 12, such as for monitoring energy usage of the different entities and for generating energy usage reports.

To accomplish energy management, the system 10 may gather information about the energy consumption and operation of each device in an entity 22 and control the facilities, buildings and devices at that entity 22, based on the energy consumption and operating information for each device, by communicating the energy consumption and operating data in real-time between the devices and the energy management system 24. Advantageously, energy management data may be received from each facility corresponding to building

control signals, energy usage signals, and weather and other external data, such as energy rates and weather forecasts. Accordingly, energy management data may be generated for facilities and equipment based on facility data and external data, thus affording energy management control of the different facilities.

In accordance with the invention, the server 12 may include a software program 18 (curtailment manager) for creating, monitoring and tracking load curtailment events within the network. A load curtailment event is broadly defined as any event causing a peak energy demand within the system. The software program 18 may include a plurality of modules for operating as the curtailment manager in accordance with the invention.

Fig. 3 is a diagram illustrating a plurality of software modules comprising the curtailment manager software application 18. As shown in Fig. 3, the curtailment manager software application 18 may include any one or more of an event creation software module 80, an event notification software module 82, an event monitor software module 84, an event trend tracker software module 86, and an event report software module 88. These software modules will be described in more detail below.

In accordance with the invention, new curtailment events may be created by a service provider operator by accessing the event creation software module 80 of the curtailment manager software application 18. A service provider operator may access the server 12, for example by using the browser software application on the client computer system 60 and after logging into the network, may create a curtailment event. Upon selecting to create a curtailment event, the curtailment manager software application 18 may invoke the event creation software module 80 (Fig. 3), and a user interface may be displayed to the service provider operator allowing for the creation of a new curtailment event. Figs. 4A-E are exemplary representations of a user interface that may be displayed to a service provider operator upon accessing the event creation software module 80.

As shown in Figs. 4A-E, a user interface 90 that may be displayed to a service provider operator may include a plurality of individual tabbed windows 92a-e that permit the user to input event parameter information into the event creation software module 80. For example, by selecting tabbed window 92a (Fig. 4A), an operator may establish a new curtailment event program by entering curtailment program data into the various data fields

provided, such as program name, whether participation in the curtailment program is mandatory, the manner in which energy costs are determined, and which facilities are eligible for the curtailment event program.

By selecting tabbed window 92b (Fig. 4B), an operator may provide facility-specific information for facilities that may participate in a curtailment program, such as facility name, account number information, energy meter information, committed energy reduction information, and customer contact information. Different curtailment programs may also be associated with a particular facility, using a program selector portion 94.

By selecting tabbed window 92c (Fig. 4C), an operator may select from different baseline algorithms that may be used to indicate energy usage and expected energy usage results by participating in a particular curtailment program. A baseline is a particular set of energy values indicated over a period of time. A baseline algorithm is a particular method for computing the baseline values. Advantageously, different baseline algorithms may be used to calculate baseline values and an operator may select from the available baseline algorithms when creating a new curtailment program.

Examples of some baseline algorithms that may be used by the system are described briefly below. Those skilled in the art will recognize that other baseline algorithms may be utilized without departing from the invention. A first baseline algorithm that may be utilized by the system may determine baseline information by determining an average energy load during a period of time, for example, the five highest energy consuming days that occurred over a thirty day period.

Another baseline algorithm that may be utilized by the system may determine baseline information by computing an estimated baseline over a time period, for example, occurring one day before a curtailment notice is transmitted, and two hours earlier than the curtailment event is scheduled to begin, and calculating the energy usage over a one hour period. To illustrate the above, if a curtailment event is set for December 3rd at 12 PM and a notification is transmitted on December 2nd, according to this baseline algorithm, an estimated baseline is computed using December 1st and the time period 10AM-11AM as default measures. Accordingly, once a curtailment event begins, an actual baseline may be calculated in place of the estimated baseline. The actual baseline calculation may be computed, for example, by

determining energy usage for a time period, such as two hours prior to the start of the curtailment event, and measuring energy usage over a one hour time period. In certain circumstances, a notice may be issued to customers at a time when the data required for baseline calculation is not available. Advantageously, the system may calculate an estimated baseline using the best available data, to aid in customer evaluation of the offer, and a final baseline may be recalculated at the actual start of the event.

Returning to Figs. 4A-4E, by selecting tabbed window 92d (Fig. 4D), an operator may provide season parameter information for defining the time periods that are used by the system to analyze curtailment data. Finally, by selecting tabbed window 92e (Fig. 4E), an operator may select particular system default information, such as screen refresh periods, time zone information and program provider information

Once curtailment programs have been created, a service provider operator may select to initiate a particular curtailment program during a period of peak energy demand. To initiate a curtailment program, a service provider operator may log into the system 10, such as by using the web browser software application on the client computer system 60 and interact with the server 12 to access the curtailment manager software application 18. The curtailment manager software application 18 may invoke the event notification software module 82 (Fig. 3), and a user interface may be displayed to the service provider operator allowing the operator to initiate a curtailment event. Fig. 5 is an exemplary representation of a user interface that may be displayed to a service provider operator upon accessing the event notification software module 82.

As shown in Fig. 5, a user interface 100 that may be displayed to the service provider operator may include a plurality of associated data fields 102 for indicating curtailment event parameter information, such as curtailment program information, facility designation, dates and times for effecting the curtailment event, and price information relating to the cost of energy while participating in the curtailment event. The price information may include a single price, a series of time based prices, or reference to wholesale or retail market indexes. Additionally, the user interface may include an area 104 for graphically depicting curtailment events showing for each curtailment program, for example, the total committed reduction in energy usage for each hour of the day. Finally, the user interface 100 may also include an area 106 for indicating historical information relating to recent curtailment events. Thus, by

accessing the event notification software module 82, a service provider operator may initiate particular curtailment programs and target them to specific customer groups. Preferably, event notification is transmitted immediately, however, notifications may also be periodically transmitted to each client node 14 without departing from the invention. In order to properly notify the client node 14, an appropriate individual at each client node 14 is personally notified, for example, by pager, by e-mail, and/or by Personal Data Assistant (PDA) of initiation of a new curtailment event.

Upon receiving a notification from the system 10, a consumer at a client node 14 may use a client computer system 60 and access the server 12, for example by using the web browser software application. The consumer may log into the system 10, for example by providing a particular user name and/or password to the system, and after being verified as authentic, may access the curtailment manager software application 18 to respond to an event notification. The curtailment manager software application 18 may invoke the event notification software module 82 (Fig. 3), and a user interface may be displayed to the consumer allowing for responding to the event notification. Fig. 6 is an exemplary representation of a user interface 110 that may be displayed to a consumer upon accessing the event notification software module 82.

As shown in Fig. 6, the user interface 110 may include an area 112 for indicating curtailment event parameter information, such as the date and time of a particular curtailment event, event duration and energy cost while participating in the curtailment event. Additionally, the user interface 110 may include a plurality of data fields 114 for receiving event response parameter information, such as committed energy reduction information that is entered by the consumer. The user interface 110 may also include an area 116 for graphically depicting energy usage baseline information of the consumer. Preferably, the baseline information is specific to each client node 14 and may be calculated as described above.

Before selecting whether to participate in the curtailment event and indicating a committed reduction, a consumer may also review facility-specific information, such as recent energy usage profiles, local weather forecasts, or other significant operating conditions that may effect energy usage, as well as reviewing prior curtailment history. Fig. 7 is an

exemplary representation of a user interface that may be displayed to a consumer for reviewing facility-specific information.

After analyzing curtailment event information and facility-specific information, a consumer may select whether to participate in an offered curtailment event. Advantageously, multiple site facilities may select different facilities to participate in a particular curtailment event using the user interface 110, for example by selecting from different site facilities via a drop down menu or the like (not shown in Fig. 6).

In accordance with the invention, both service provider operators and consumers may monitor the results of participating in a curtailment event in real-time. By accessing the server 12, such as by using the web browser software application on a client computer system 60, a service provider operator or a consumer may access the curtailment manager software application 18 and select to monitor the results of curtailment event participation. The curtailment manager software application 18 may invoke the event monitor software module 84 (Fig. 3) that allows a user to view the current energy reduction achieved by participating in a curtailment event, the remaining time of the curtailment event, energy costs saved by participating in the curtailment event, as well as energy costs saved over a particular period of time, and a comparison of actual energy usage with baseline energy usage.

Upon a service provider operator accessing the event monitor software module 84, a user interface may be displayed to the service provider operator allowing for the monitoring of a curtailment event. Fig. 8 is an exemplary representation of a user interface 120 that may be displayed to a service provider operator upon accessing the event monitor software module 84.

As shown in Fig. 8, the user interface 120 may include an area 122 for indicating curtailment event parameter information, such as a facility designated to participate in the curtailment program, date and time information relating to the curtailment event, and energy cost information for participating in the curtailment event. The user interface 120 may also include an area 124 for indicating event performance information, such as the number of curtailment events offered and accepted, committed energy usage reduction information, an amount of energy saved by the facility by participating in the curtailment event, as well as an aggregate energy usage reduction for all participated curtailment events by that facility.

The user interface 120 may also include an area 126 for indicating cost information, such as the cost of energy usage while participating in the curtailment event. Seasonal information may also be indicated, such as the number of participated curtailment events, total energy savings, total cost, etc, over a period of time. Additionally, the user interface 120 may include an area 128 for graphically depicting real-time energy usage information. Preferably, the real-time energy usage information may be compared with baseline energy usage information (described above) so that a service provider operator can rapidly determine expected energy usage. Thus, an operator may monitor, in real-time, the results of a curtailment event. This real-time information may be automatically updated in the user's browser so that the user is assured of having the most current information available.

A consumer may also monitor, in real-time, the results of a curtailment event, as described above. Fig. 9 is an exemplary representation of a user interface 130 that may be displayed to a consumer upon accessing the event monitor software module 84. As shown in Fig. 9, the user interface 130 may include an area 132 for indicating curtailment event parameter information, such as a facility designated with a particular curtailment program, date and time information relating to the curtailment event, and energy cost information for participating in the curtailment event. The user interface 130 may also include an area 134 for indicating event response parameter information, such as committed energy usage reduction, an estimated amount of energy saved by participating in the curtailment event, as well as estimated energy costs saved by the facility by participating in the curtailment event, and expected compensation information for participating in the curtailment event.

The user interface 130 may also include an area 136 for indicating actual event parameter information, such as time remaining for a curtailment event, actual current and average energy reduction information, actual energy saved by participating in the curtailment event, as well as the actual energy costs saved by participating in the curtailment event. Additionally, the user interface 130 may also include an area 138 for graphically depicting real-time energy usage information. Preferably, the real-time energy usage information may be compared with baseline energy usage information (described above) so that a consumer can rapidly determine excessive energy usage. Thus, a consumer may monitor, in real-time, the results of participating in a curtailment event.

In accordance with the invention, a service provider operator and/or consumer may analyze energy usage trends by facility over a particular period of time. By accessing the server 12, such as by using the web browser software application on a client computer system 60, a service provider operator or a consumer may access the curtailment manager software application 18 and select to view energy usage trends. The curtailment manager software application 18 may invoke the event trend tracker software module 86 (Fig. 3), and a user interface may be displayed to the service provider or consumer indicating energy usage trends.

Fig. 10 is an exemplary representation of a user interface 140 that may be displayed to a user upon accessing the event trend tracker software module 86. As shown in Fig. 10, energy usage trends may be illustrated graphically indicating energy usage for a particular facility over a period of time. Alternatively, energy usage trends may also be illustrated in tabular form.

As described above, reports for documenting performance and payment for participating in curtailment events may be generated by the system 10. By accessing the server 12, such as by using the web browser software application on the client computer system 60, a service provider operator may access the curtailment manager software application 18 that may invoke the event reporting software module 88 (Fig. 3). The event reporting software module 88 allows a user to generate reports relating to different curtailment events. Advantageously, reports may be exported by the system, and may be incorporated into spreadsheets or billing systems, for example.

Upon accessing the event reporting software module 88, a user interface may be displayed to the service provider operator allowing for the generating and printing of reports relating to different curtailment events. Fig. 11 is an exemplary representation of a user interface 150 that may be displayed to the service provider operator upon accessing the event reporting software module 88.

As shown in Fig. 11, the user interface 150 indicates report results relating to different curtailment events. For example, report results may be viewed for particular curtailment events and may indicate curtailment event parameter information, such as event dates and

duration, price for participating, baseline energy usage, actual energy usage, energy reduction, and cost information.

A consumer may also access the event reporting software module 88, and a user interface 160 may be displayed to the consumer allowing the consumer to generate and view curtailment event reports. Fig. 12 is an exemplary representation of a user interface that may be displayed to the consumer upon accessing the event reporting software module 88. As shown in Fig. 12, report results may be viewed for particular facilities and may indicate curtailment event parameter information, such as duration, price for participating, baseline energy usage, actual energy usage, energy reduction, and cost information. Advantageously, reports may be exported by the system, and may be incorporated into spreadsheets or billing systems, for example.

Fig. 13 is a flowchart illustrating a preferred method of operation for the system described above. Initially, a service provider operator may log into the network, as described above, and access the curtailment manager software application 18 to create a new curtailment event (Step 170). Upon accessing the software application 18 to create a curtailment event, the event creation software module 80 may be invoked by the software application 18 allowing the service provider operator to create a new curtailment event program (Step 171). After creating a curtailment event program, the service provider operator may choose to initiate a particular curtailment event program by accessing the event notification software module 82 (Step 172). Once a curtailment event is targeted to particular client nodes, an event notification may be transmitted to each of the nodes (Step 173) indicating a pending event. There is significant logic and complexity in how the system manages multiple simultaneous overlapping events of different types. In some cases, events are terminated, in other cases they are split and reorganized based on a set of rules.

Generally, curtailment events may be classified as mandatory events or voluntary events. Mandatory events are those for which participation is mandatory. Typically, such programs are governed by regulated tariff filings and require a long-term contractual agreement between the utility and the customer. Compensation for participating in a mandatory program is usually not based on a per-event basis, but instead on the stipulated terms of the contract. Voluntary events are those for which participation is voluntary.

Typically, such programs compensate customers for the amount of energy curtailed during the event.

As described above, in accordance with the invention, the occurrence of a new mandatory event may replace an existing mandatory event if it conflicts, either partially or fully, with the existing event, whether the existing event has been acknowledged or not. For example, if the existing event has not yet been acknowledged by the customer, the notice for that event may disappear, and if the existing event has already been acknowledged by the customer, that event may be removed from the monitoring screen.

A new mandatory event may supersede or replace an existing voluntary event. For example, if the existing voluntary event has not yet been accepted by the customer, the notice for that event may disappear and the mandatory event may effectively supercede the voluntary event. If the existing voluntary event has already been accepted by the customer, the mandatory event may supercede the voluntary event during conflicting hours. For example, if the mandatory event participation period entirely conflicts with the voluntary event participation period, the voluntary event may be effectively canceled. Similarly, if the mandatory event participation period only partially conflicts with the voluntary event participation period, the existing voluntary event may be superceded at those conflicting times, or alternatively, the voluntary event may be effectively split, and new voluntary events may be created that can be monitored separately.

A new voluntary event may replace an existing voluntary event if it conflicts, either partially or fully, with the existing event, depending on whether the existing event has been accepted by the customer. For example, if the existing event has not yet been accepted, the notice for that event may disappear. If the existing event has already been accepted by the customer, the new voluntary event notification may not be presented to the customer. Moreover, a voluntary event notice cannot be sent to a facility for which a mandatory event notice has already been submitted for the same time period, regardless of whether the notice has been acknowledged.

After receiving an event notification, a consumer at the notified client nodes may log into the network and access the event notification software module 82 (Step 174) and select whether to respond to a curtailment event (Step 175). After selecting whether to participate

in a curtailment event, both consumers and/or service provider operators may access the network to monitor, in real-time, the progress of participating in the curtailment event by accessing the event monitor software module 84 (Step 176). Energy usage trends may also be monitored by accessing the event trend tracker software module 86, as described above (Step 177). Finally, both a service provider operator and a consumer may access the event report software module 88 as described above and generate report results relating to particular curtailment events (Step 178).

Accordingly, the present invention affords an infrastructure for creating, monitoring, and settling curtailment events. By using the invention, commercial and industrial users may respond to and benefit from requests for load reduction. Advantageously, curtailment events may be issued in the aggregate, or may be customized for each customer according to curtailment program design and customer type and location. Both market price based curtailment programs and legacy interrupterable load programs are supported by the invention. Advantageously, data gathering and event participation patterns may also be customized, and end-user participation may be logged and can be presented in a variety of different forms to both consumers and service provider operators. Also, multiple time zones for customers and events may be supported.

While the foregoing has been described with reference to particular embodiments of the invention, such as a system and method for creating, monitoring and settling curtailment events, the invention is not limited to such embodiments and may be applicable to any system capable of performing the described advantages. It will be appreciated by those skilled in the art that changes in these embodiments may be made without departing from the principles and spirit of the invention.

WHAT IS CLAIMED IS:

1. A system for performing energy load management within a network, comprising:

an energy service provider node for providing energy to the network;

a plurality of client nodes for receiving portions of the provided energy from the energy service provider node to operate energy dependent devices within the client nodes;

a server for coordinating energy load management within the network, the server including

an event creator for creating an energy curtailment program;

an event notifier for initiating the energy curtailment program and for notifying any of the client nodes of the energy curtailment program so that the client nodes may elect to participate in the energy curtailment program;

an event monitor for monitoring the progress of the energy curtailment program in reducing energy usage of the participating client nodes; and

an event reporter for generating report results relating to the energy curtailment program; and

a database associated with the server for storing energy usage information about the energy usage of the client nodes and for storing energy curtailment program information.

2. The system of Claim 1, wherein the energy service provider node is a utility provider.

3. The system of Claim 1, wherein the plurality of client nodes include entities having multiple site facilities.

4. The system of Claim 1, wherein the plurality of client nodes include single site facilities.

5. The system of Claim 1, wherein each of the facilities in the plurality of client nodes include an internal data source and an external data source.

6. The system of Claim 5, wherein the internal and external data sources generate data about a respective facility that is used for energy management.

7. The system of Claim 5, wherein the internal data source includes a building control gateway for providing two-way data communications between existing controls of the facility and an energy management system associated with the facility, a meter gateway for providing

data to the associated energy management system about the energy usage of the facility, and a weather gateway for providing weather data to the associated energy management system.

8. The system of Claim 7, wherein the weather data includes humidity and temperature information.

9. The system of Claim 5, wherein the external data source includes a market energy rates source for providing energy cost information relating to different energy providers and a weather data source for providing future weather forecast information.

10. The system of Claim 5, wherein each facility further includes a local energy management system.

11. The system of Claim 11, wherein the local energy management system includes an energy manager sub-system for analyzing energy usage data, a facility navigator sub-system for permitting simulated visualization of the facility, a facility manager sub-system for analyzing control problems within the facility, and an alarm manager sub-system for notifying of and responding to system generated alarms.

12. The system of Claim 1, wherein the event notifier includes event logic for managing the occurrence of multiple overlapping events.

13. The system of Claim 1, wherein the server further includes an event trend tracker for tracking energy usage of different client nodes over a period of time.

14. A system for performing energy load management within a network, comprising:

means for providing energy to the network;

means for receiving portions of the provided energy to operate energy dependent devices;

means for coordinating energy load management within the network including

means for creating an energy curtailment program;

means for initiating the energy curtailment program and for notifying of the pending energy curtailment program so that participation in the energy curtailment program can be elected;

means for monitoring the progress of the energy curtailment program in reducing energy usage within the network; and

means for generating report results relating to the energy curtailment program; and

means for storing energy usage information about the energy usage within the network for storing energy curtailment program information.

15. The system of Claim 14, wherein the means for coordinating energy load management within the network further includes means for tracking energy usage within the network over a period of time.

16. The system of Claim 14, wherein the means for notifying includes event logic for managing the occurrence of multiple overlapping events.

17. A computer program product for use in performing energy load management within a network, comprising:

an event creation software module for creating an energy curtailment program;

an event notifier software module for initiating the energy curtailment program and for notifying of the initiation of the energy curtailment program so that participation in the curtailment program may be elected;

an event monitor software module for monitoring and recording the progress of the energy curtailment program in reducing energy usage within the network during the energy curtailment program; and

an event reporter software module for generating report results relating to the energy curtailment program.

18. The computer program product of Claim 17, further comprising an event trend tracking software module for tracking energy usage trends within the network.

19. The computer program product of Claim 17, wherein the event notifier software module includes instructions for causing a computer system to manage occurrences of multiple overlapping events.

20. A computer program residing on a computer-readable medium, comprising instructions for causing a computer system to:

receive a creation command to create an energy curtailment program;

receive a select command for selecting to initiate the energy curtailment program;

transmit a notification alert to any of a plurality of client nodes about the initiation of the energy curtailment program and to manage the occurrences of multiple overlapping events;

receive a participation command from the notified client nodes to associate the energy curtailment program with those client nodes electing to participate in the energy curtailment program;

monitor the progress of the energy curtailment program in reducing energy usage by the participating client nodes; and

receive a report command to generate report results relating to the energy curtailment program.

21. The computer program of Claim 20, wherein the progress of the energy curtailment program is monitored in real-time.

22. A method for performing energy load management within a network, comprising the steps of:

receiving energy curtailment program parameter information to create an energy curtailment program;

initiating the energy curtailment program;

notifying any of a plurality of client nodes about the initiation of the energy curtailment program by providing the energy curtailment program parameter information and baseline energy usage information to the client nodes to assist the notified client nodes in electing whether to participate in the energy curtailment program; and

monitoring and recording the progress of the energy curtailment program in reducing energy usage by the participating client nodes.

23. The method of Claim 22, wherein the baseline energy usage information is determined according to a predetermined baseline algorithm.

24. The method of Claim 23, wherein the baseline algorithm determines an average energy load during the five highest energy consuming days occurring over a thirty day time period and the result is used as the baseline energy usage information.

25. The method of Claim 23, wherein the baseline algorithm determines estimated baseline information by determining the energy usage occurring over a one hour time period occurring one day and two hours prior to the scheduled beginning of a curtailment program, and once the curtailment program begins, the baseline algorithm substitutes actual baseline information for the estimated baseline information by determining energy usage over a one hour time period occurring two hours prior to the start of the curtailment program.

26. The method of Claim 22, wherein the progress of the curtailment program is monitored in real-time.

27. The method of Claim 22, further comprising the step of generating report results relating to the energy curtailment program.

28. The method of Claim 27, wherein the report results are customized to particular client nodes.

29. The method of Claim 22, wherein the notifying step includes managing occurrences of multiple overlapping events.

30. A system for performing energy load management within a network, comprising:

a server for coordinating energy load management within the network, the server including

an event creator for creating an energy curtailment program;

an event notifier for initiating the energy curtailment program and for notifying of the pending energy curtailment program so that participation in the energy curtailment program can be elected;

an event monitor for monitoring the progress of the energy curtailment program in reducing energy usage within the network; and

an event reporter for generating report results relating to the energy curtailment program; and

a database associated with the server for storing energy usage information about the energy usage within the network and for storing energy curtailment program information.

31. The system of Claim 30, wherein the server further includes an event trend tracker for tracking energy usage within the network over a period of time.

32. The system of Claim 30, wherein the event notifier includes event logic for managing occurrences of multiple overlapping events.

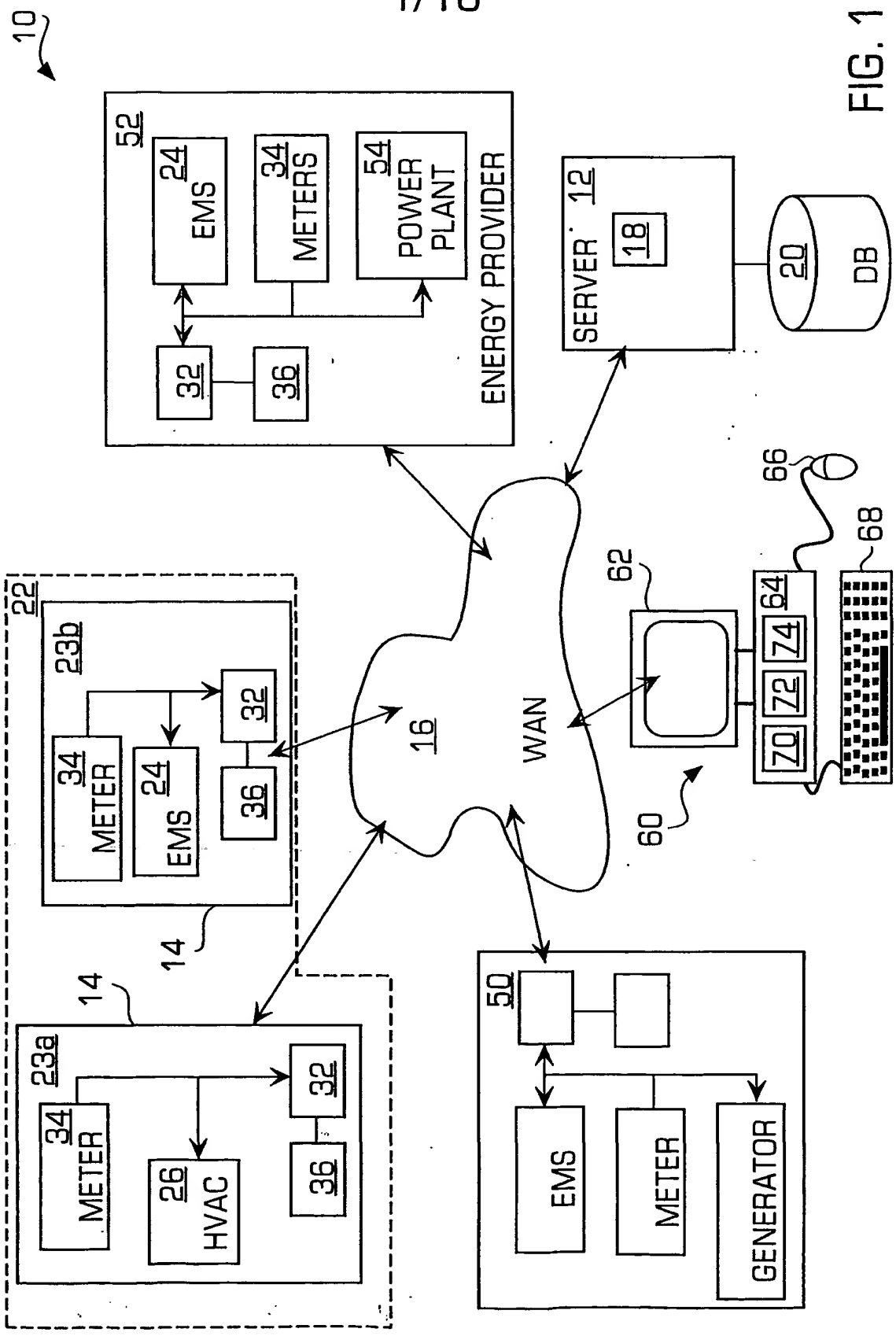

10
52
24
EMS
34
METERS
54
POWER PLANT
32
36
ENERGY PROVIDER
SERVER 12
18
20
DB
66
68
62
64
74
72
70
60
16
WAN
22
23b
34
METER
24
EMS
32
36
14
14
23a
34
METER
26
HVAC
32
36
50
EMS
METER
GENERATOR

FIG. 1

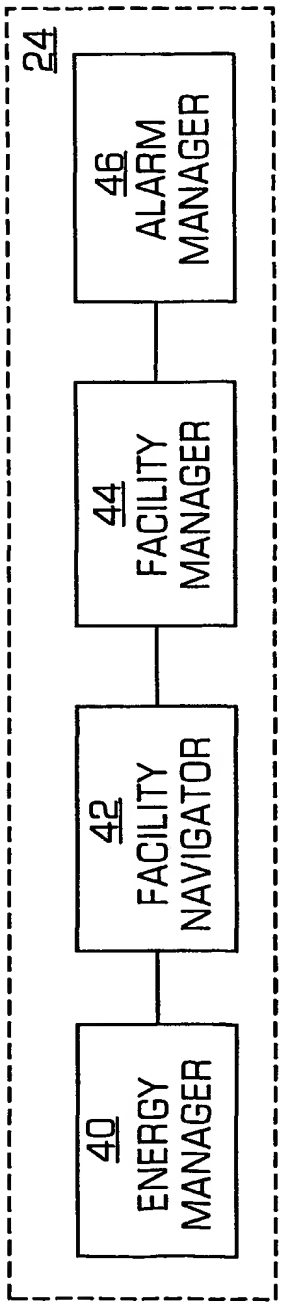

24
40 ENERGY MANAGER
42 FACILITY NAVIGATOR
44 FACILITY MANAGER
46 ALARM MANAGER

FIG. 2

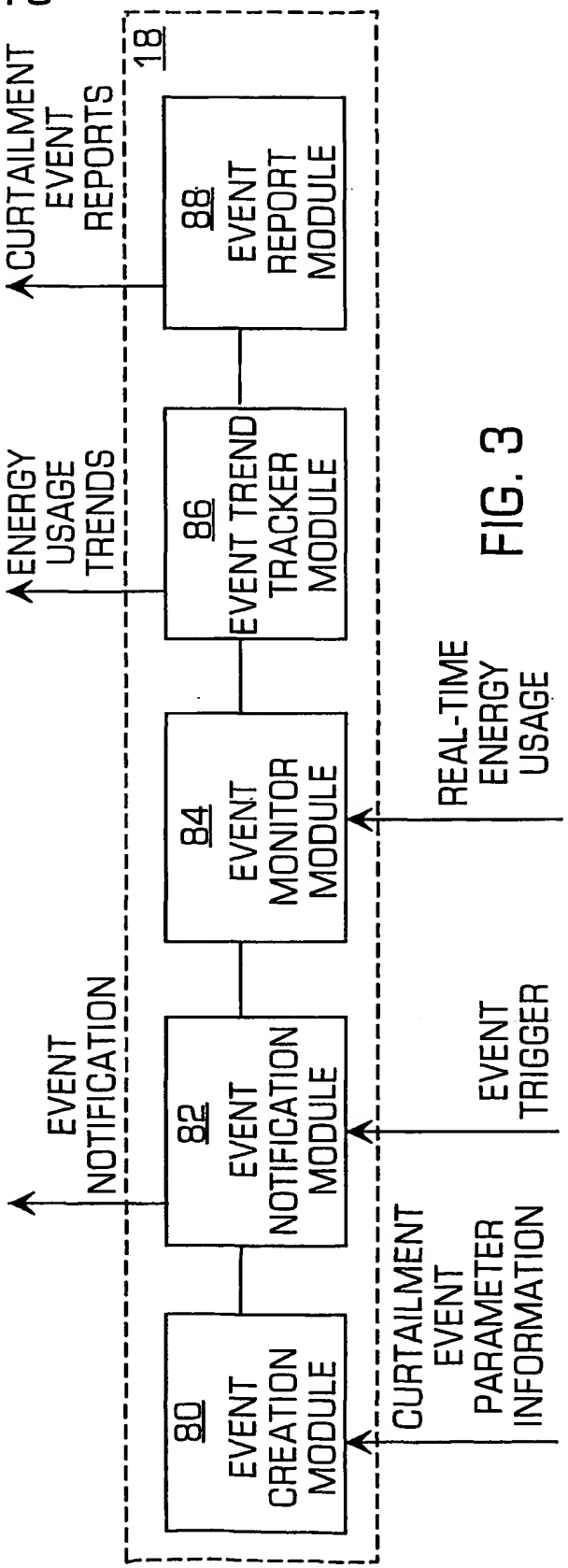

18
80 EVENT CREATION MODULE
82 EVENT NOTIFICATION MODULE
84 EVENT MONITOR MODULE
86 EVENT TREND TRACKER MODULE
88 EVENT REPORT MODULE
CURTAILMENT EVENT PARAMETER INFORMATION
EVENT TRIGGER
REAL-TIME ENERGY USAGE
EVENT NOTIFICATION
ENERGY USAGE TRENDS
CURTAILMENT EVENT REPORTS

FIG. 3

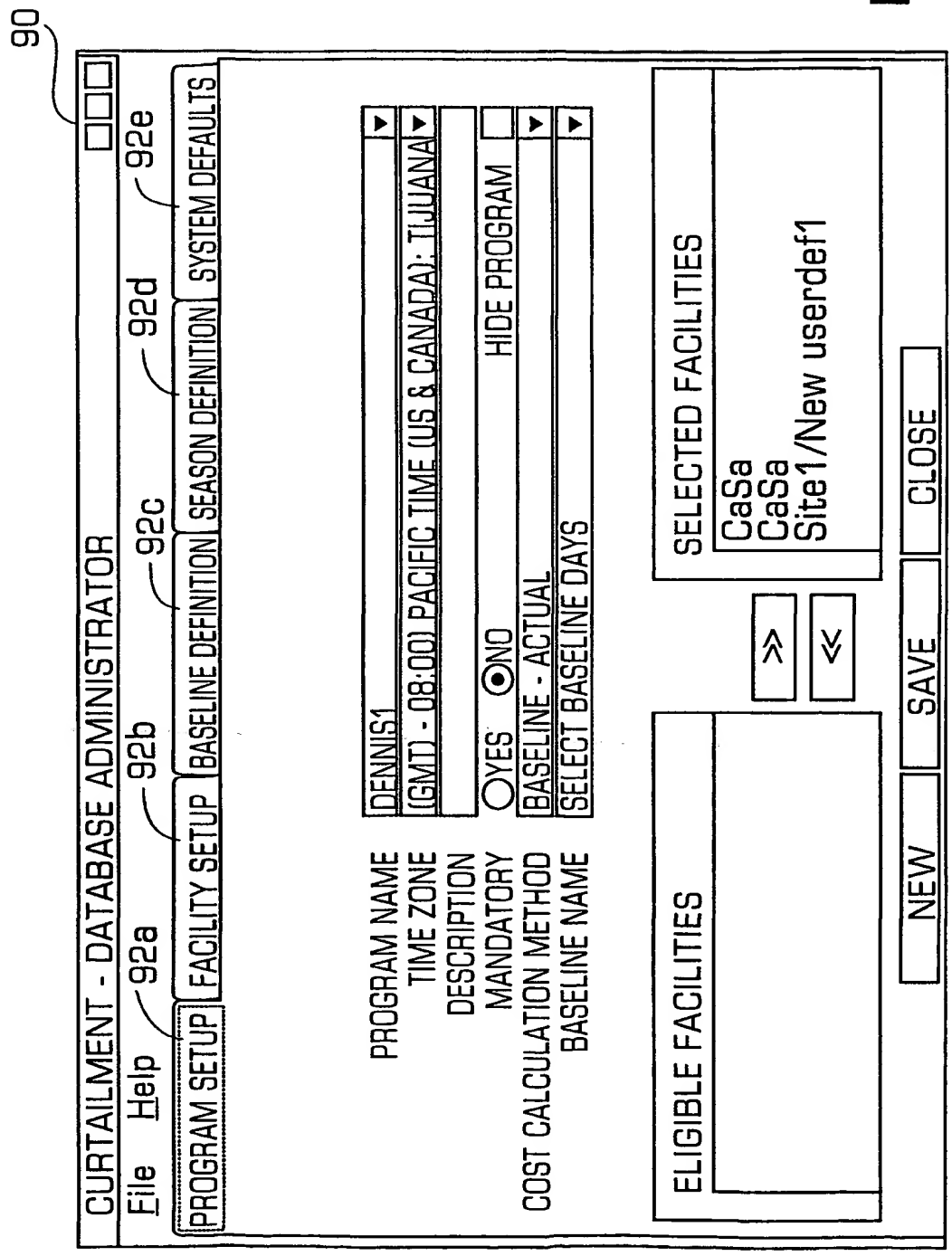

90
CURTAILMENT - DATABASE ADMINISTRATOR
File Help
92a
PROGRAM SETUP
92b
FACILITY SETUP
92c
BASELINE DEFINITION
92d
SEASON DEFINITION
92e
SYSTEM DEFAULTS
PROGRAM NAME
TIME ZONE
DESCRIPTION
MANDATORY
COST CALCULATION METHOD
BASELINE NAME
DENNIS1
(GMT) - 08:00) PACIFIC TIME (US & CANADA): TIJUANA
YES NO
HIDE PROGRAM
BASELINE - ACTUAL
SELECT BASELINE DAYS
ELIGIBLE FACILITIES
>>
<<
SELECTED FACILITIES
CaSa
CaSa
Site1/New userdef1
NEW
SAVE
CLOSE

FIG. 4A

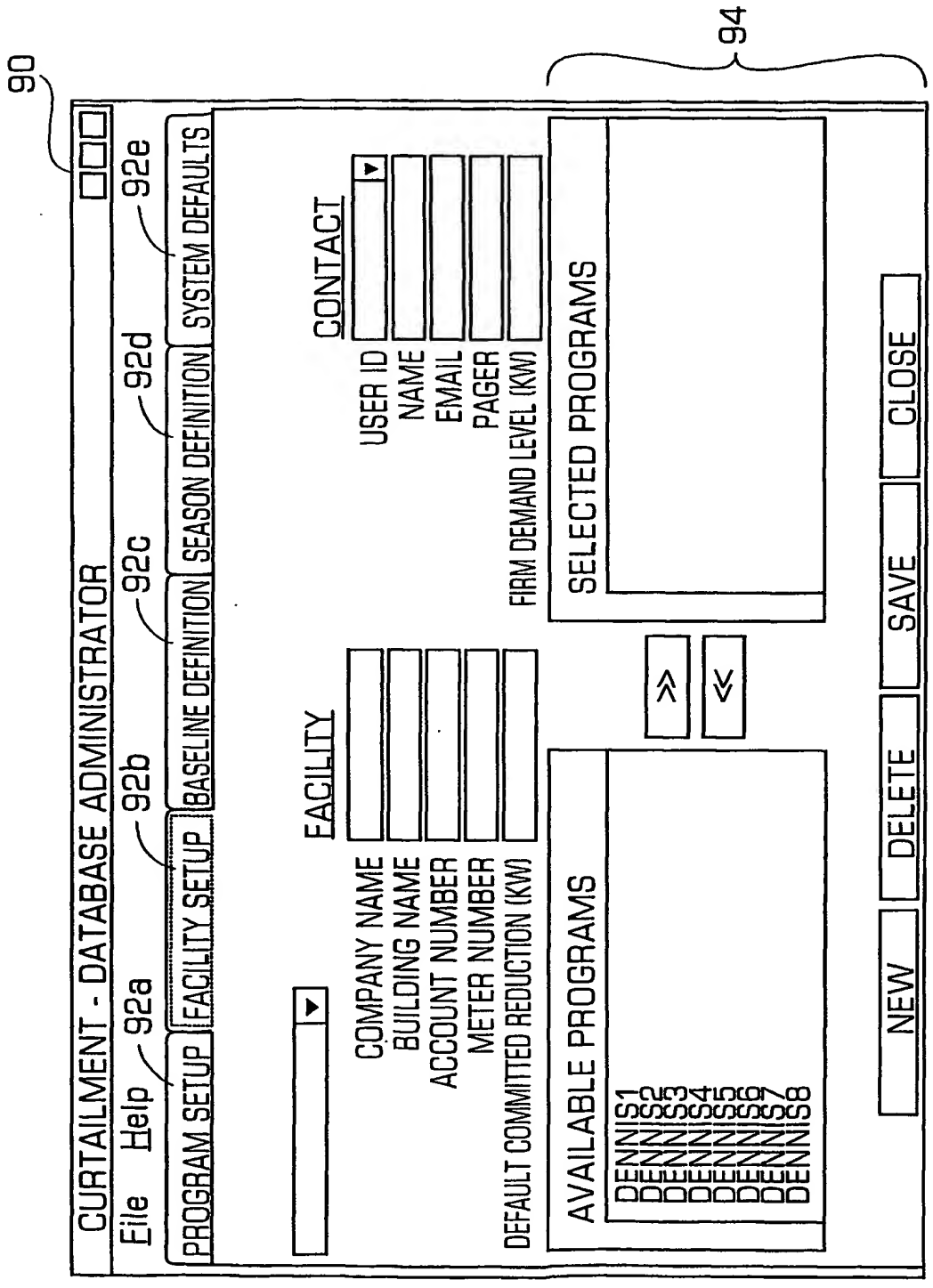

90
94
CURTAILMENT - DATABASE ADMINISTRATOR
File Help
92a
92b
92c
92d
92e
PROGRAM SETUP
FACILITY SETUP
BASELINE DEFINITION
SEASON DEFINITION
SYSTEM DEFAULTS
FACILITY
COMPANY NAME
BUILDING NAME
ACCOUNT NUMBER
METER NUMBER
DEFAULT COMMITTED REDUCTION (KW)
CONTACT
USER ID
NAME
EMAIL
PAGER
FIRM DEMAND LEVEL (KW)
AVAILABLE PROGRAMS
DENNIS1
DENNIS2
DENNIS3
DENNIS4
DENNIS5
DENNIS6
DENNIS7
DENNIS8
>>
<<
SELECTED PROGRAMS
NEW
DELETE
SAVE
CLOSE

FIG. 4B

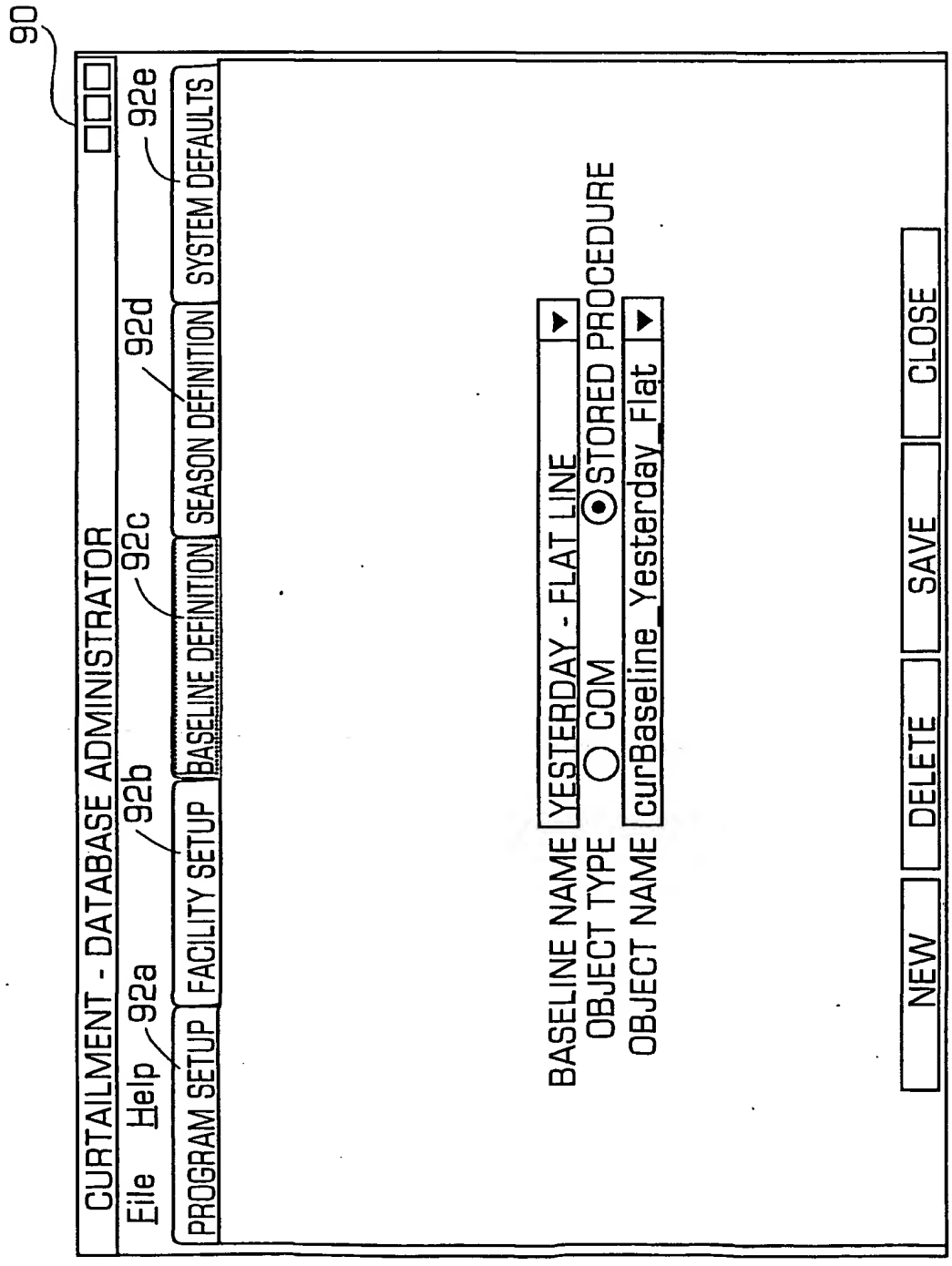

90
CURTAILMENT - DATABASE ADMINISTRATOR
File Help
92a
92b
92c
92d
92e
PROGRAM SETUP
FACILITY SETUP
BASELINE DEFINITION
SEASON DEFINITION
SYSTEM DEFAULTS
BASELINE NAME
YESTERDAY - FLAT LINE
OBJECT TYPE
COM
STORED PROCEDURE
OBJECT NAME
curBaseline_Yesterday_Flat
NEW
DELETE
SAVE
CLOSE

FIG. 4C

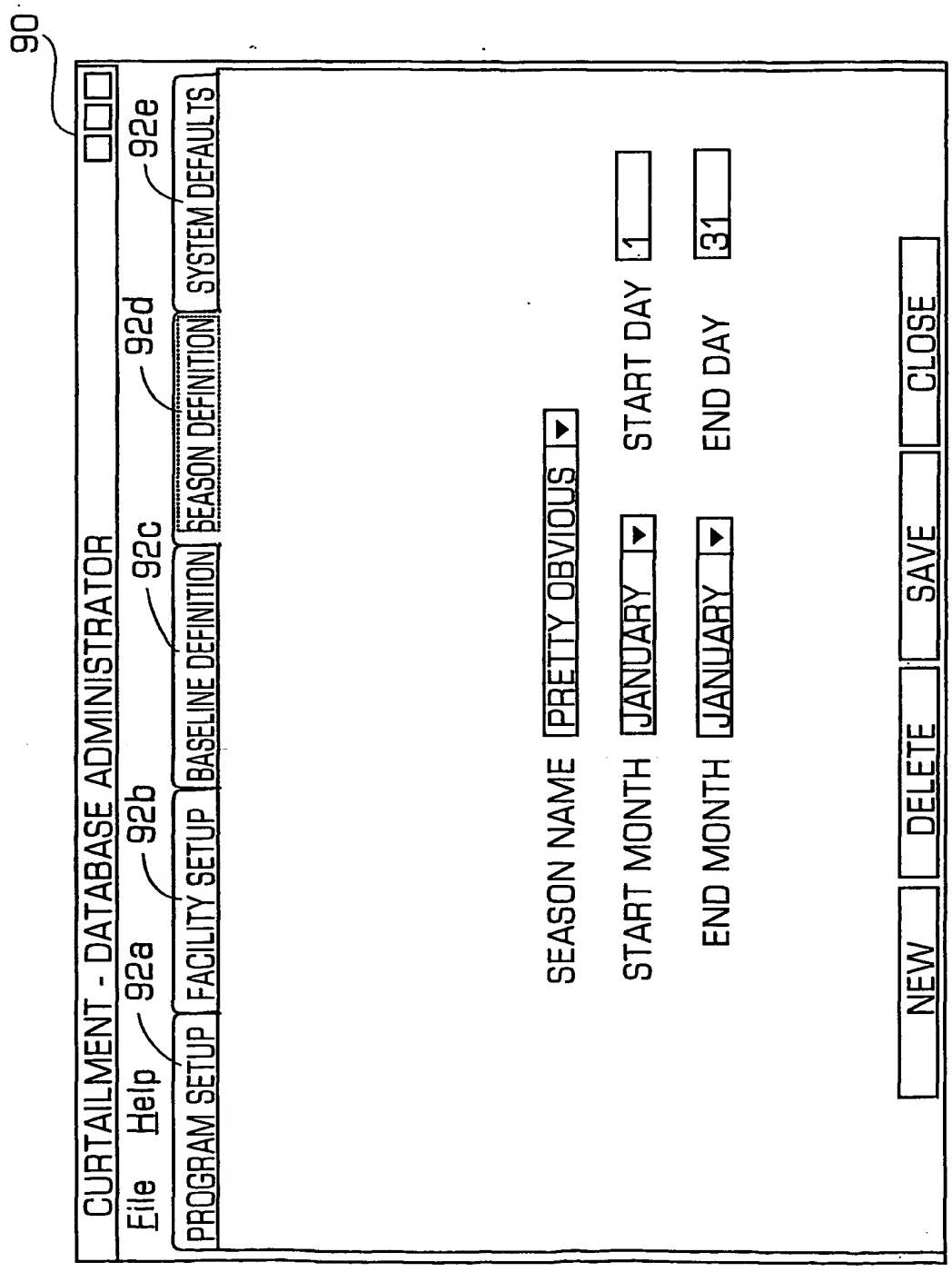
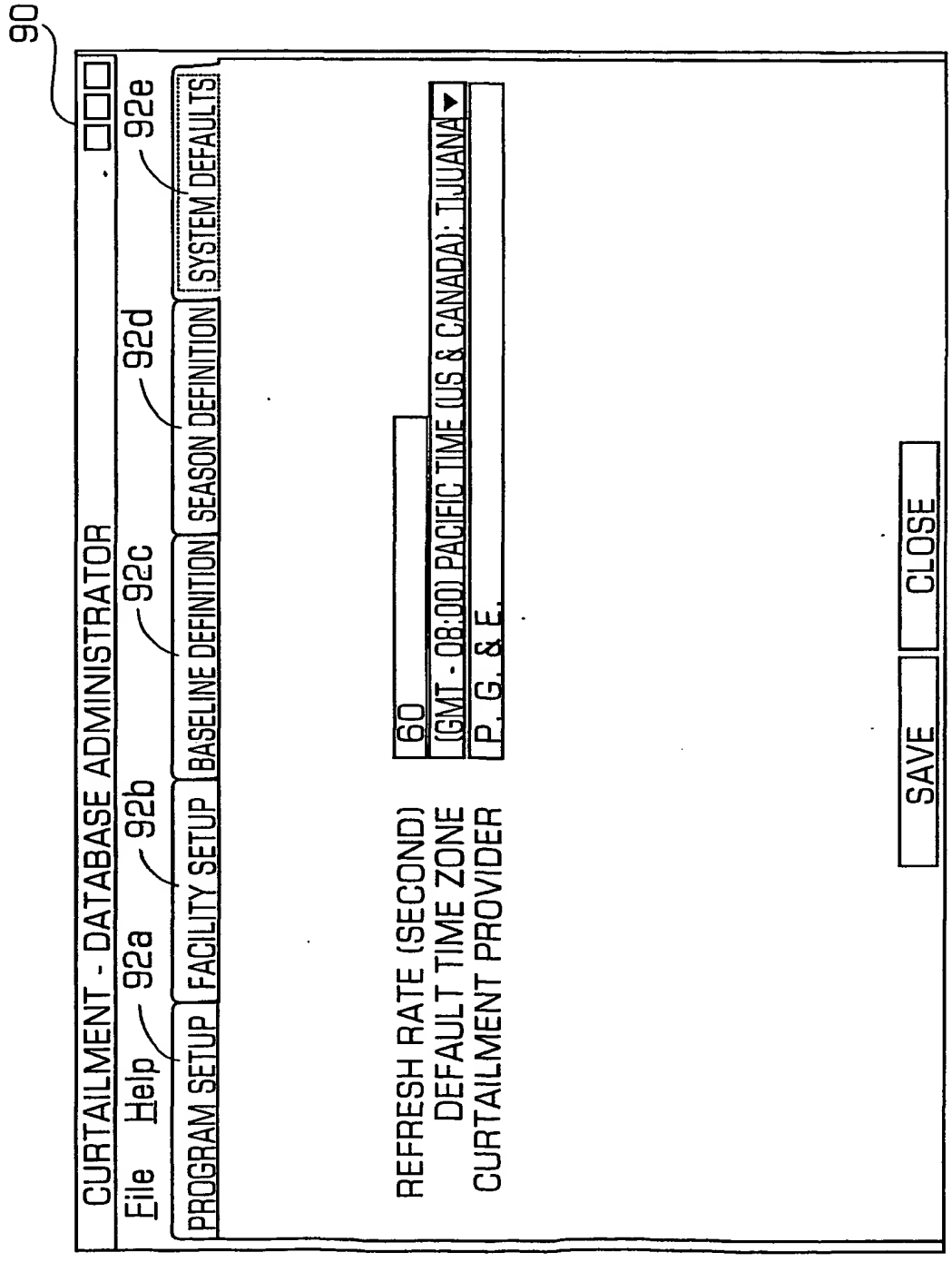

90
CURTAILMENT - DATABASE ADMINISTRATOR
File Help
92a
92b
92c
92d
92e
PROGRAM SETUP
FACILITY SETUP
BASELINE DEFINITION
SEASON DEFINITION
SYSTEM DEFAULTS
SEASON NAME
PRETTY OBVIOUS
START MONTH
JANUARY
START DAY
1
END MONTH
JANUARY
END DAY
31
NEW
DELETE
SAVE
CLOSE

FIG. 4D

FIG. 4E


90
CURTAILMENT - DATABASE ADMINISTRATOR
File Help
92a
92b
92c
92d
92e
PROGRAM SETUP
FACILITY SETUP
BASELINE DEFINITION
SEASON DEFINITION
SYSTEM DEFAULTS
REFRESH RATE (SECOND)
DEFAULT TIME ZONE
CURTAILMENT PROVIDER
60
(GMT - 08:00) PACIFIC TIME (US & CANADA); TIJUANA
P. G. & E.
SAVE
CLOSE

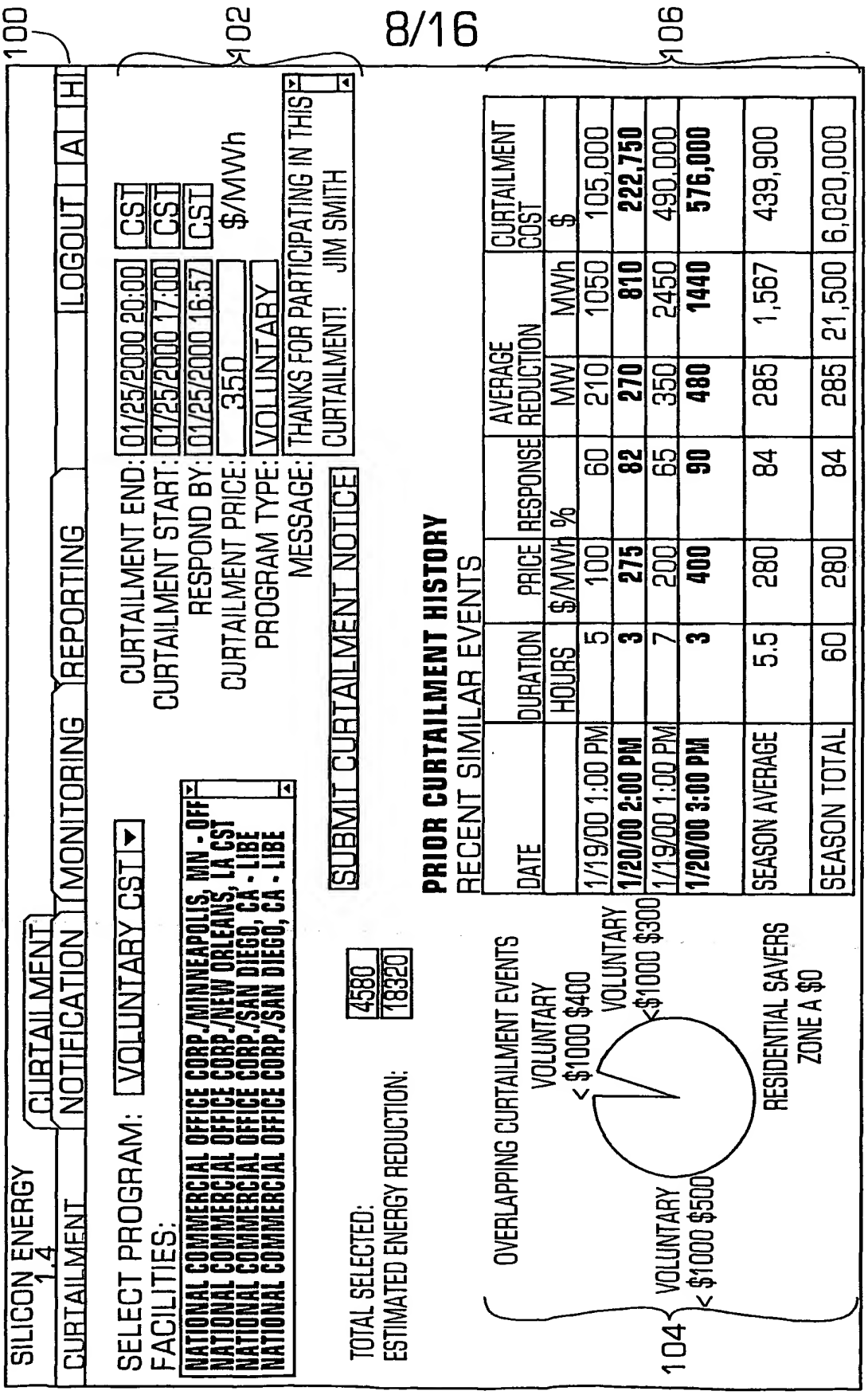

100
8/16
102
106
SILICON ENERGY 1.4
CURTAILMENT
NOTIFICATION
MONITORING
REPORTING
LOGOUT
A
HI
SELECT PROGRAM: VOLUNTARY CST
FACILITIES:
NATIONAL COMMERCIAL OFFICE CORP./MINNEAPOLIS, MN - OFF
NATIONAL COMMERCIAL OFFICE CORP./NEW ORLEANS, LA CST
NATIONAL COMMERCIAL OFFICE CORP./SAN DIEGO, CA - LIBE
NATIONAL COMMERCIAL OFFICE CORP./SAN DIEGO, CA - LIBE
CURTAILMENT END: 01/25/2000 20:00 CST
CURTAILMENT START: 01/25/2000 17:00 CST
RESPOND BY: 01/25/2000 16:57 CST
CURTAILMENT PRICE: 350 $/MWh
PROGRAM TYPE: VOLUNTARY
MESSAGE: THANKS FOR PARTICIPATING IN THIS CURTAILMENT! JIM SMITH
SUBMIT CURTAILMENT NOTICE
TOTAL SELECTED: 4580
ESTIMATED ENERGY REDUCTION: 18320
PRIOR CURTAILMENT HISTORY
RECENT SIMILAR EVENTS
DATE
DURATION HOURS
PRICE $/MWh
RESPONSE %
AVERAGE REDUCTION MW
AVERAGE REDUCTION MWh
CURTAILMENT COST $
1/19/00 1:00 PM 5 100 60 210 1050 105,000
1/20/00 2:00 PM 3 275 82 270 810 222,750
1/19/00 1:00 PM 7 200 65 350 2450 490,000
1/20/00 3:00 PM 3 400 90 480 1440 576,000
SEASON AVERAGE 5.5 280 84 285 1,567 439,900
SEASON TOTAL 60 280 84 285 21,500 6,020,000
104
OVERLAPPING CURTAILMENT EVENTS
VOLUNTARY < $1000 $400
VOLUNTARY <$1000 $300
VOLUNTARY < $1000 $500
RESIDENTIAL SAVERS ZONE A $0

FIG. 5

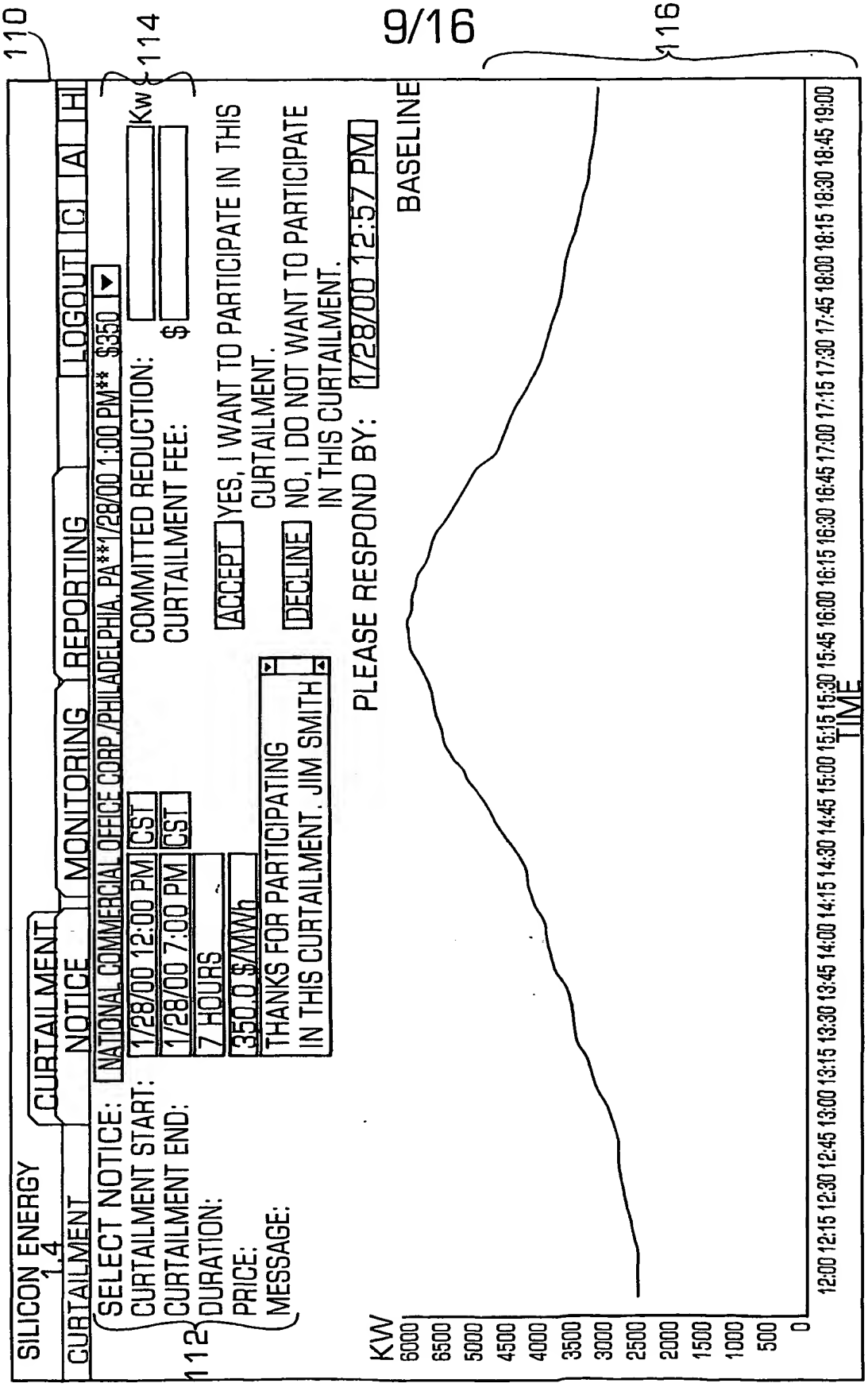

110
SILICON ENERGY
1.4
CURTAILMENT
CURTAILMENT
NOTICE
MONITORING
REPORTING
LOGOUT
IC
AI
HI
SELECT NOTICE:
NATIONAL COMMERCIAL OFFICE CORP./PHILADELPHIA, PA**1/28/00 1:00 PM** $350
CURTAILMENT START:
1/28/00 12:00 PM
CST
CURTAILMENT END:
1/28/00 7:00 PM
CST
DURATION:
7 HOURS
PRICE:
350.0 $/MWh
MESSAGE:
THANKS FOR PARTICIPATING
IN THIS CURTAILMENT. JIM SMITH
112
114
Kw
COMMITTED REDUCTION:
CURTAILMENT FEE:
$
ACCEPT
YES, I WANT TO PARTICIPATE IN THIS
CURTAILMENT.
DECLINE
NO, I DO NOT WANT TO PARTICIPATE
IN THIS CURTAILMENT.
PLEASE RESPOND BY:
1/28/00 12:57 PM
9/16
116
BASELINE
KW
6000
6500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
12:00 12:15 12:30 12:45 13:00 13:15 13:30 13:45 14:00 14:15 14:30 14:45 15:00 15:15 15:30 15:45 16:00 16:15 16:30 16:45 17:00 17:15 17:30 17:45 18:00 18:15 18:30 18:45 19:00
TIME

FIG. 6

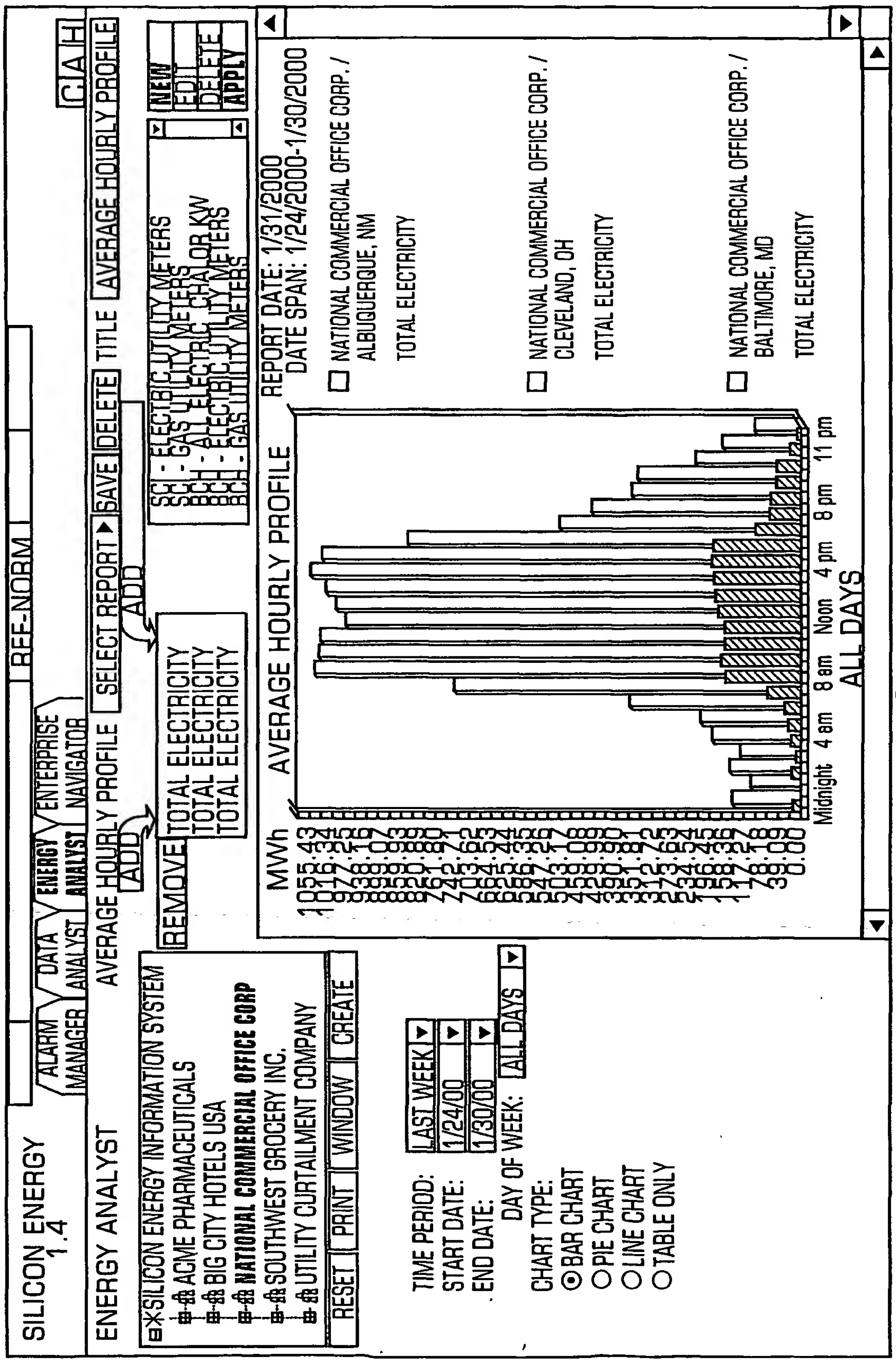

SILICON ENERGY 1.4
REF-NORM
ALARM MANAGER
DATA ANALYST
ENERGY ANALYST
ENTERPRISE NAVIGATOR
CIAH
ENERGY ANALYST
AVERAGE HOURLY PROFILE
SELECT REPORT
SAVE
DELETE
TITLE
AVERAGE HOURLY PROFILE
SILICON ENERGY INFORMATION SYSTEM
ACME PHARMACEUTICALS
BIG CITY HOTELS USA
NATIONAL COMMERCIAL OFFICE CORP
SOUTHWEST GROCERY INC.
UTILITY CURTAILMENT COMPANY
RESET
PRINT
WINDOW
CREATE
ADD
ADD
REMOVE
TOTAL ELECTRICITY
TOTAL ELECTRICITY
TOTAL ELECTRICITY
SCH - ELECTRIC UTILITY METERS
SCH - GAS UTILITY METERS
BCH - ALL ELECTRIC, CHA OR KW
BCH - ELECTRIC UTILITY METERS
BCH - GAS UTILITY METERS
NEW
EDIT
DELETE
APPLY
TIME PERIOD:
LAST WEEK
START DATE:
1/24/00
END DATE:
1/30/00
DAY OF WEEK:
ALL DAYS
CHART TYPE:
BAR CHART
PIE CHART
LINE CHART
TABLE ONLY
AVERAGE HOURLY PROFILE
REPORT DATE: 1/31/2000
DATE SPAN: 1/24/2000-1/30/2000
NATIONAL COMMERCIAL OFFICE CORP. / ALBUQUERQUE, NM
TOTAL ELECTRICITY
NATIONAL COMMERCIAL OFFICE CORP. / CLEVELAND, OH
TOTAL ELECTRICITY
NATIONAL COMMERCIAL OFFICE CORP. / BALTIMORE, MD
TOTAL ELECTRICITY
MWh
Midnight
4 am
8 am
Noon
4 pm
8 pm
11 pm
ALL DAYS

FIG. 7

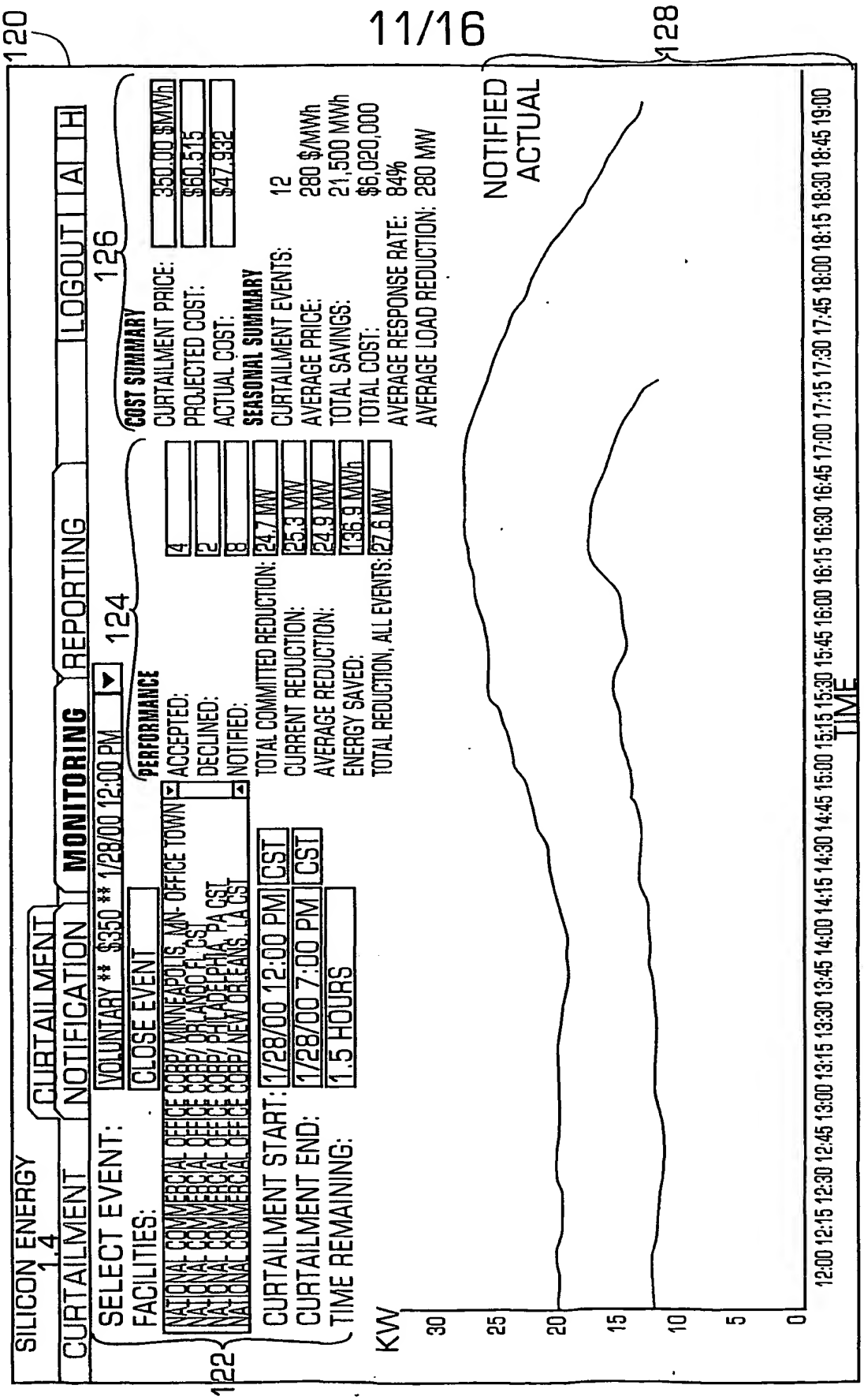

120
SILICON ENERGY
1.4
CURTAILMENT
CURTAILMENT
NOTIFICATION
MONITORING
REPORTING
LOGOUT
A
H
SELECT EVENT:
VOLUNTARY ** $350 ** 1/28/00 12:00 PM
124
126
FACILITIES:
CLOSE EVENT
NATIONAL COMMERCIAL OFFICE COBB/ MINNEAPOLIS, MN- OFFICE TOWN
NATIONAL COMMERCIAL OFFICE COBB/ ORLANDO,FL CST
NATIONAL COMMERCIAL OFFICE COBB/ PHILADELPHIA, PA CST
NATIONAL COMMERCIAL OFFICE COBB/ NEW ORLEANS, LA CST
122
CURTAILMENT START: 1/28/00 12:00 PM CST
CURTAILMENT END: 1/28/00 7:00 PM CST
TIME REMAINING: 1.5 HOURS
PERFORMANCE
ACCEPTED: 4
DECLINED: 2
NOTIFIED: 8
TOTAL COMMITTED REDUCTION: 24.7 MW
CURRENT REDUCTION: 25.3 MW
AVERAGE REDUCTION: 24.9 MW
ENERGY SAVED: 136.9 MWh
TOTAL REDUCTION, ALL EVENTS: 27.6 MW
COST SUMMARY
CURTAILMENT PRICE: 350.00 $/MWh
PROJECTED COST: $60,515
ACTUAL COST: $47,932
SEASONAL SUMMARY
CURTAILMENT EVENTS: 12
AVERAGE PRICE: 280 $/MWh
TOTAL SAVINGS: 21,500 MWh
TOTAL COST: $6,020,000
AVERAGE RESPONSE RATE: 84%
AVERAGE LOAD REDUCTION: 280 MW
128
NOTIFIED
ACTUAL
KW
30
25
20
15
10
5
0
12:00 12:15 12:30 12:45 13:00 13:15 13:30 13:45 14:00 14:15 14:30 14:45 15:00 15:15 15:30 15:45 16:00 16:15 16:30 16:45 17:00 17:15 17:30 17:45 18:00 18:15 18:30 18:45 19:00
TIME

FIG. 8

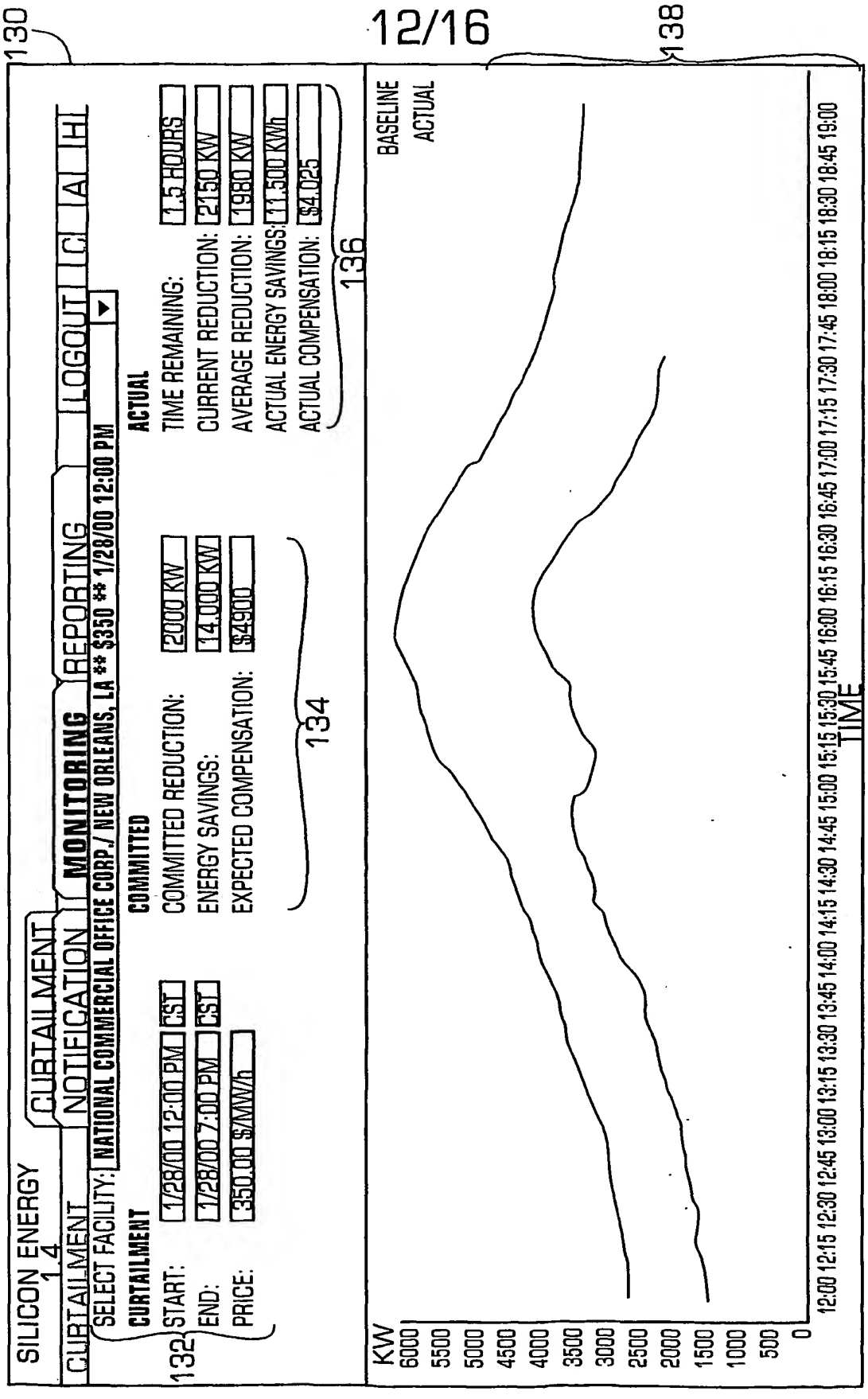

130
SILICON ENERGY
14
CURTAILMENT
NOTIFICATION
MONITORING
REPORTING
LOGOUT
SELECT FACILITY: NATIONAL COMMERCIAL OFFICE CORP./ NEW ORLEANS, LA ** $350 ** 1/28/00 12:00 PM
CURTAILMENT
COMMITTED
ACTUAL
132
START: 1/28/00 12:00 PM EST
END: 1/28/00 7:00 PM EST
PRICE: 350.00 $/MW/h
COMMITTED REDUCTION: 2000 KW
ENERGY SAVINGS: 14,000 KW
EXPECTED COMPENSATION: $4900
TIME REMAINING: 1.5 HOURS
CURRENT REDUCTION: 2150 KW
AVERAGE REDUCTION: 1980 KW
ACTUAL ENERGY SAVINGS: 11,500 KWh
ACTUAL COMPENSATION: $4,025
134
136
138
BASELINE
ACTUAL
KW
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
12:00 12:15 12:30 12:45 13:00 13:15 13:30 13:45 14:00 14:15 14:30 14:45 15:00 15:15 15:30 15:45 16:00 16:15 16:30 16:45 17:00 17:15 17:30 17:45 18:00 18:15 18:30 18:45 19:00
TIME

FIG. 9

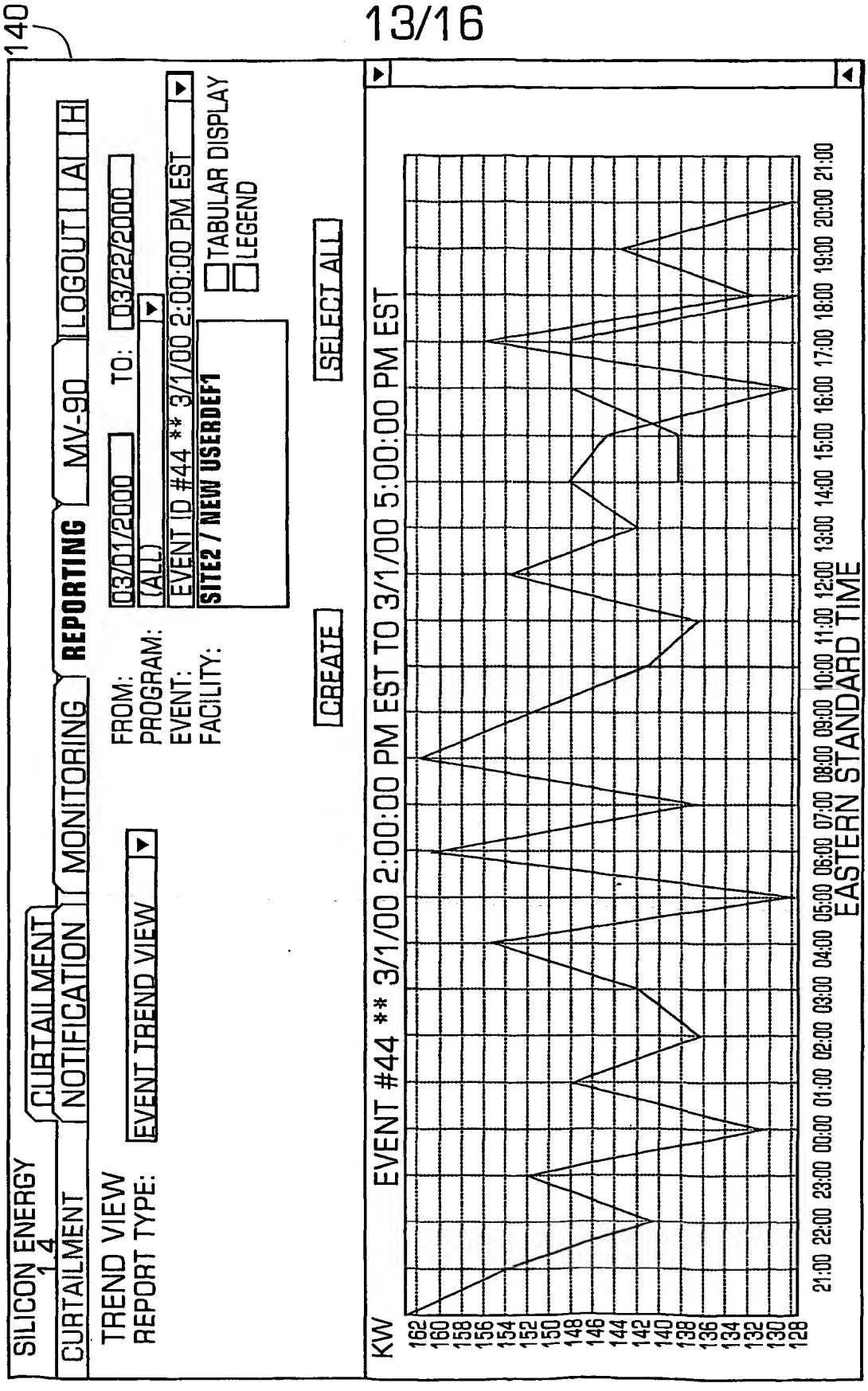

140
SILICON ENERGY 1.4
CURTAILMENT
NOTIFICATION
MONITORING
REPORTING
MV-90
LOGOUT
A
H
TREND VIEW
REPORT TYPE:
EVENT TREND VIEW
FROM:
PROGRAM:
EVENT:
FACILITY:
03/01/2000
TO:
03/22/2000
(ALL)
EVENT ID #44 ** 3/1/00 2:00:00 PM EST
SITE2 / NEW USERDEF1
TABULAR DISPLAY
LEGEND
CREATE
SELECT ALL
KW
EVENT #44 ** 3/1/00 2:00:00 PM EST TO 3/1/00 5:00:00 PM EST
162
160
158
156
154
152
150
148
146
144
142
140
138
136
134
132
130
128
21:00 22:00 23:00 00:00 01:00 02:00 03:00 04:00 05:00 06:00 07:00 08:00 09:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00
EASTERN STANDARD TIME

FIG. 10

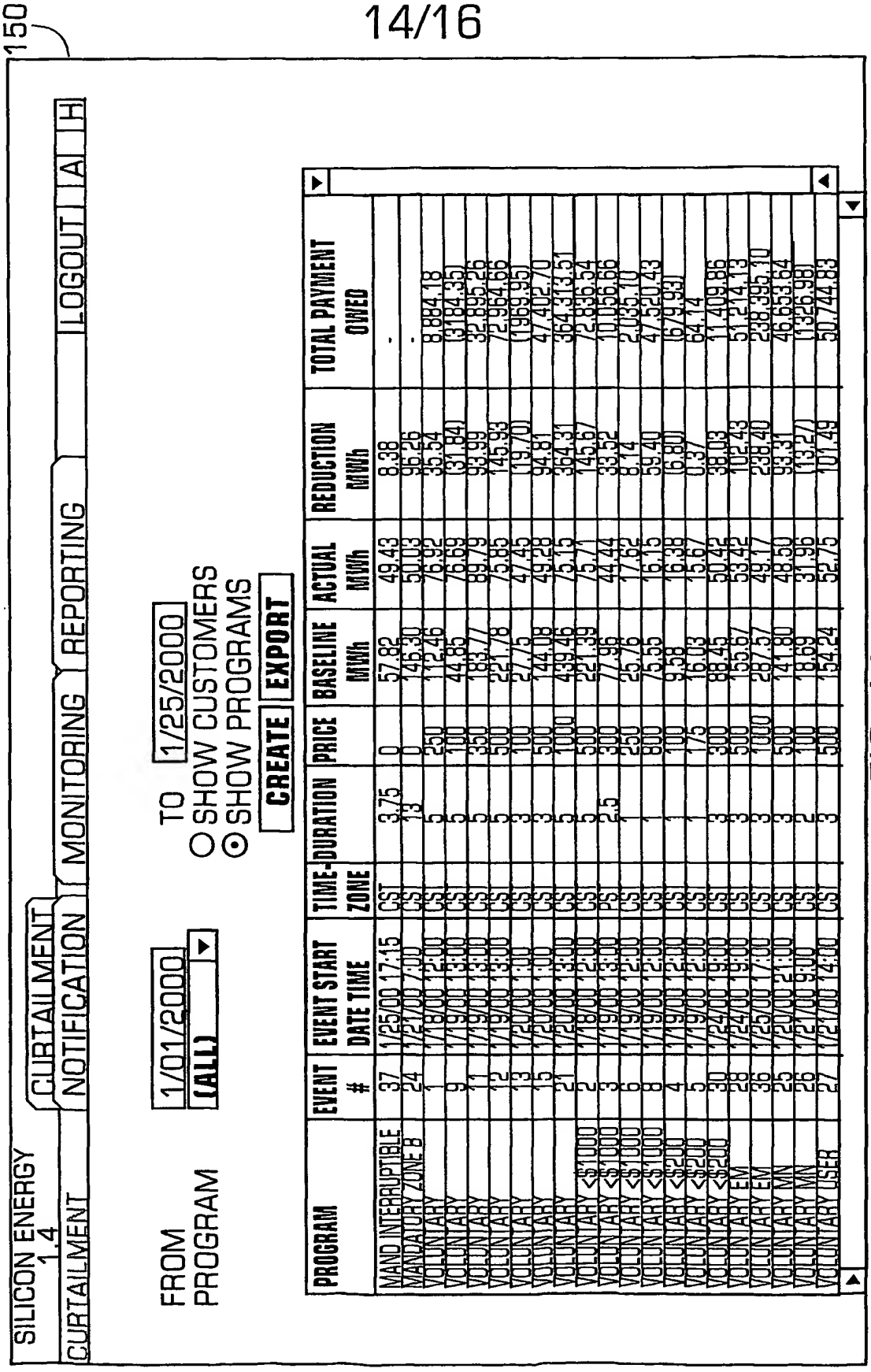

150
SILICON ENERGY 1.4
CURTAILMENT
NOTIFICATION
MONITORING
REPORTING
LOGOUT
A
H
FROM 1/01/2000
PROGRAM (ALL)
TO 1/25/2000
SHOW CUSTOMERS
SHOW PROGRAMS
CREATE
EXPORT
PROGRAM
EVENT #
EVENT START DATE TIME
TIME-ZONE
DURATION
PRICE
BASELINE MWh
ACTUAL MWh
REDUCTION MWh
TOTAL PAYMENT OWED
MAND INTERRUPTIBLE 37 1/25/00 17:15 CST 3.75 0 57.82 49.43 8.38 -
MANDATORY ZONE B 24 1/21/00 7:00 CST 13 0 146.30 50.03 96.26 -
VOLUNTARY 1 1/18/00 12:00 CST 5 250 112.46 76.92 35.54 8,884.18
VOLUNTARY 9 1/19/00 13:00 CST 5 100 44.85 76.69 (31.84) (3184.35)
VOLUNTARY 11 1/19/00 13:00 CST 5 350 183.77 89.79 93.99 32,895.26
VOLUNTARY 12 1/19/00 13:00 CST 5 500 221.78 75.85 145.93 72,964.66
VOLUNTARY 13 1/20/00 1:00 CST 3 100 27.75 47.45 (19.70) (1969.95)
VOLUNTARY 15 1/20/00 1:00 CST 3 500 144.08 49.28 94.81 47,402.70
VOLUNTARY 21 1/20/00 13:00 CST 5 1000 439.46 75.15 364.31 364,313.51
VOLUNTARY <$1000 2 1/18/00 12:00 CST 5 500 221.39 75.71 145.67 72,836.34
VOLUNTARY <$1000 3 1/19/00 13:00 PST 2.5 300 77.96 44.44 33.52 10,056.66
VOLUNTARY <$1000 6 1/19/00 12:00 CST 1 250 25.76 17.62 8.14 2,035.10
VOLUNTARY <$1000 8 1/19/00 12:00 CST 1 800 75.55 16.15 59.40 47,520.43
VOLUNTARY <$200 4 1/19/00 12:00 CST 1 100 9.58 16.38 (6.80) (679.93)
VOLUNTARY <$200 5 1/19/00 12:00 CST 1 175 16.03 15.67 0.37 64.14
VOLUNTARY <$200 30 1/24/00 19:00 CST 3 300 88.45 50.42 38.03 11,409.86
VOLUNTARY EM 28 1/24/00 19:00 CST 3 500 155.67 53.45 102.43 51,214.13
VOLUNTARY EM 36 1/25/00 17:00 CST 3 1000 287.57 49.17 238.40 238,395.10
VOLUNTARY MN 25 1/20/00 21:00 CST 3 500 141.80 48.50 93.31 46,653.84
VOLUNTARY MN 26 1/21/00 9:00 CST 2 100 18.69 31.96 (13.27) (1326.98)
VOLUNTARY USER 27 1/21/00 14:00 CST 3 500 154.24 52.75 101.49 50,744.83

FIG. 11

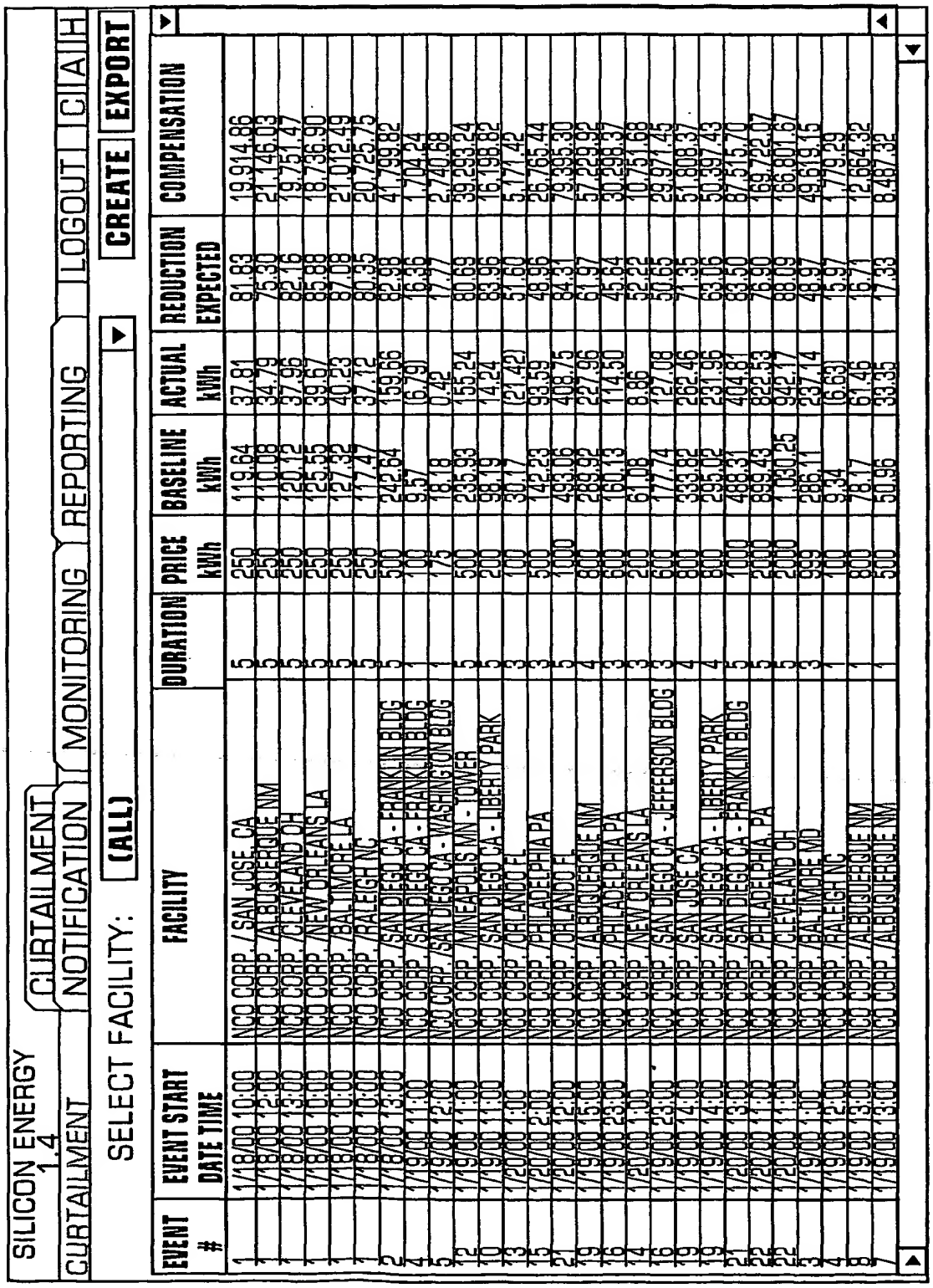

160
SILICON ENERGY 1.4
CURTAILMENT
CURTAILMENT
NOTIFICATION
MONITORING
REPORTING
LOGOUT
CIIAIIH
SELECT FACILITY:
(ALL)
CREATE
EXPORT
EVENT #
EVENT START DATE TIME
FACILITY
DURATION
PRICE kWh
BASELINE kWh
ACTUAL kWh
REDUCTION EXPECTED
COMPENSATION

FIG. 12

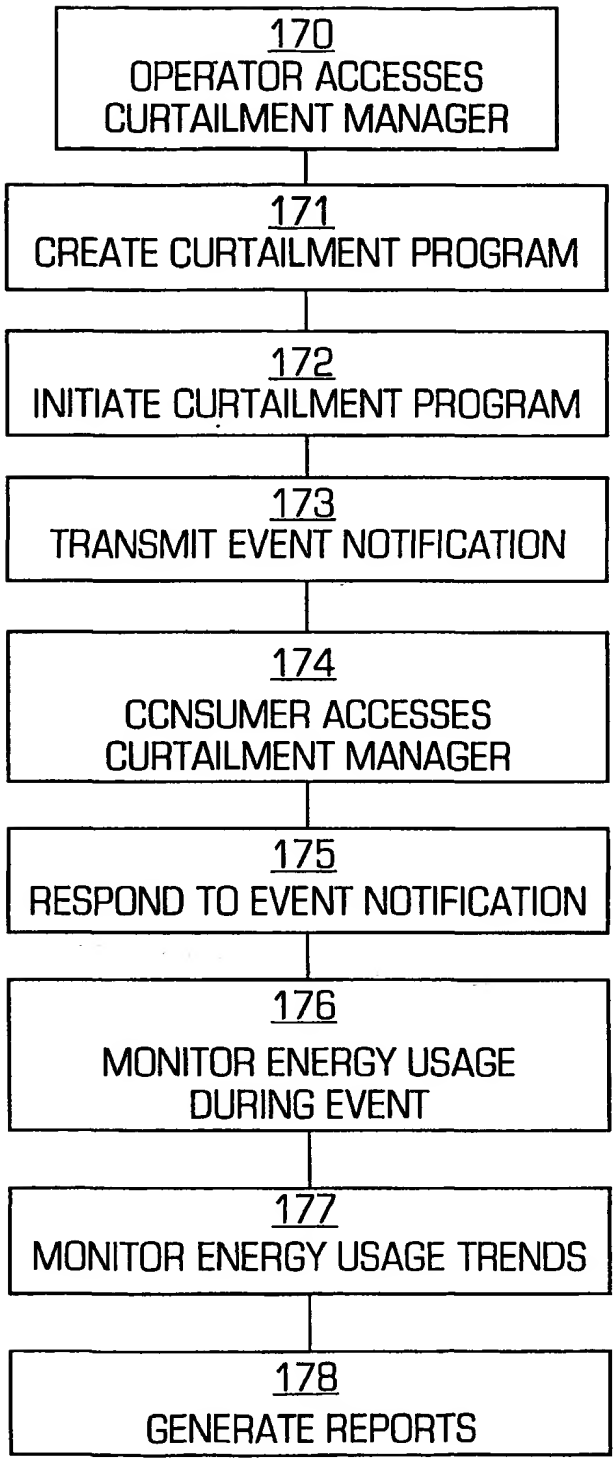

170
OPERATOR ACCESSES CURTAILMENT MANAGER
171
CREATE CURTAILMENT PROGRAM
172
INITIATE CURTAILMENT PROGRAM
173
TRANSMIT EVENT NOTIFICATION
174
CCNSUMER ACCESSES CURTAILMENT MANAGER
175
RESPOND TO EVENT NOTIFICATION
176
MONITOR ENERGY USAGE DURING EVENT
177
MONITOR ENERGY USAGE TRENDS
178
GENERATE REPORTS

FIG. 13

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US01/30489

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :G06F 19/00
US CL :705/412; 702/60,61

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 702/57, 60, 61, 62; 705/1, 8, 400, 412

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

NONE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

NONE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	FR 2600511 A (BACH et al) 04 October 1991, see abstract.	1-10 & 12-32
A	US 5,572,438 A (EHLERS et al) 05 November 1996, see abstract.	1-10 & 12-32
A	US 5,576,700 A (DAVIS et al) 19 November 1996, see abstract.	1-10 & 12-32
A	NETO: "Distribution by demand side management"; Transmission & Distribution World, December 1997, vol. 49, no. 13, pages 39-44, see entire article.	1-10 & 12-32

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

27 JANUARY 2002

Date of mailing of the international search report

14 FEB 2002

Name and mailing address of the ISA/US
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Authorized officer

Peggy Harrad

EDWARD R COSIMANO

Telephone No. (703) 305-9783

Form PCT/ISA/210 (second sheet) (July 1998)★

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US01/30489

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☒ Claims Nos.: 11
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

2.1 Since claim 11 can not depend from itself, the exact scope of claim 11 can not be determined.

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.